

# *LID Planning and Design*

# ***Presentation Highlights***

- LID Concepts  
(Issues/Principles/Practices)
- Hydrologic Concepts
- Analysis Procedures
- Demonstration

# ***Low-Impact Development (LID)***

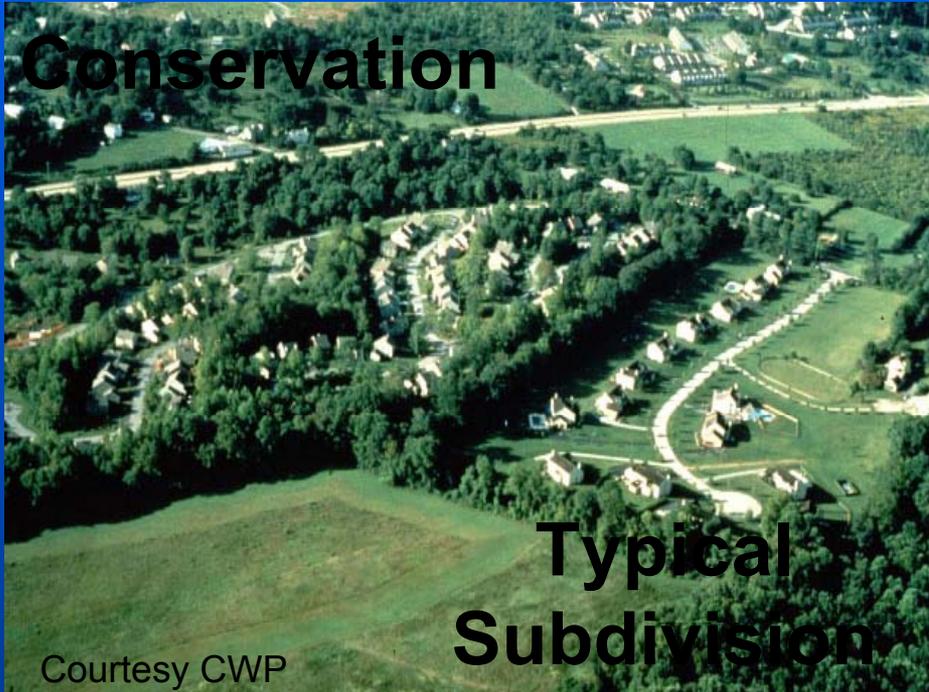
- A sustainable stormwater management technology that combines precision engineering with micro-scale controls that are engineered, designed and integrated into every site feature in order to maintain, restore or closely mimic pre-development watershed hydrologic functions (volume, recharge, evaporation and runoff).
- Opportunities to create a “customized” functional watershed to address specific regulatory or aquatic resource protection goals
- Not a land use control, but a management and design strategy that is integrated into the proposed land use

# *Basic Guiding LID Principles*

---

1. Conserve natural areas
2. Minimize development impacts
3. Maintain site runoff rate
4. Use integrated management practices
5. Implement pollution prevention, proper maintenance and public education programs

# 1. Conserve Natural Areas



- Conservation of drainages, trees & vegetation
- Land use planning
- Watershed planning
- Habitat conservation plans
- Stream & wetland buffers

## *2. Minimize Development Impacts*

- Reduce storm pipes, curbs and gutters
- Preserve sensitive soils
- Cluster buildings and reduce building footprints
- Reduce road widths
- Minimize grading
- Limit lot disturbance
- Reduce impervious surfaces
- Better Site Design Techniques

# 3. *Maintain Site Runoff Rate*

- **Maintain natural flow paths**
- **Use open drainage**
- **Flatten slopes**
- **Disperse drainage**
- **Lengthen flow paths**
- **Save headwater areas**
- **Maximize sheet flow**



# 4. *Integrated Management Practices*

- Small-scale stormwater controls
- Distributed throughout site
- Maintain flow patterns, filter pollutants and re-create or maintain hydrology

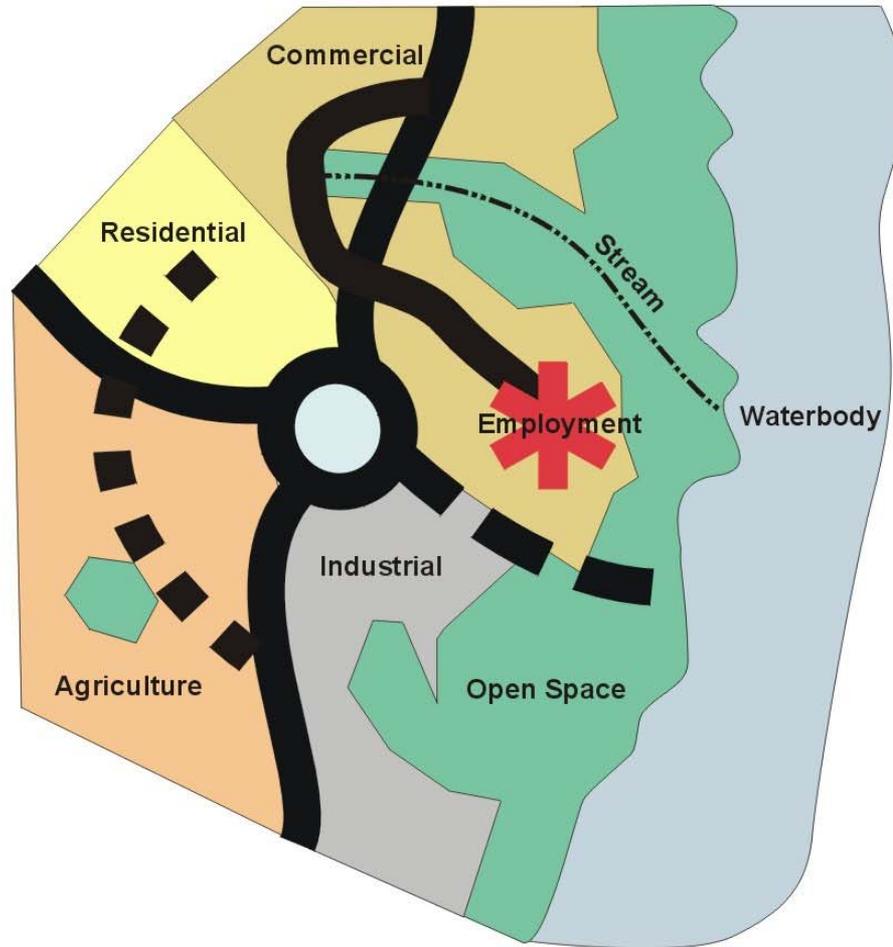
# *Common Integrated Management Practices*

---

- **Disconnectivity**
- **Bioretention**
- **Open Swales**
- **Permeable  
and Porous  
Pavements**
- Green Roofs
- Planter Boxes
- Soil Amendment
- Sand Filters
- Inlet Retrofits

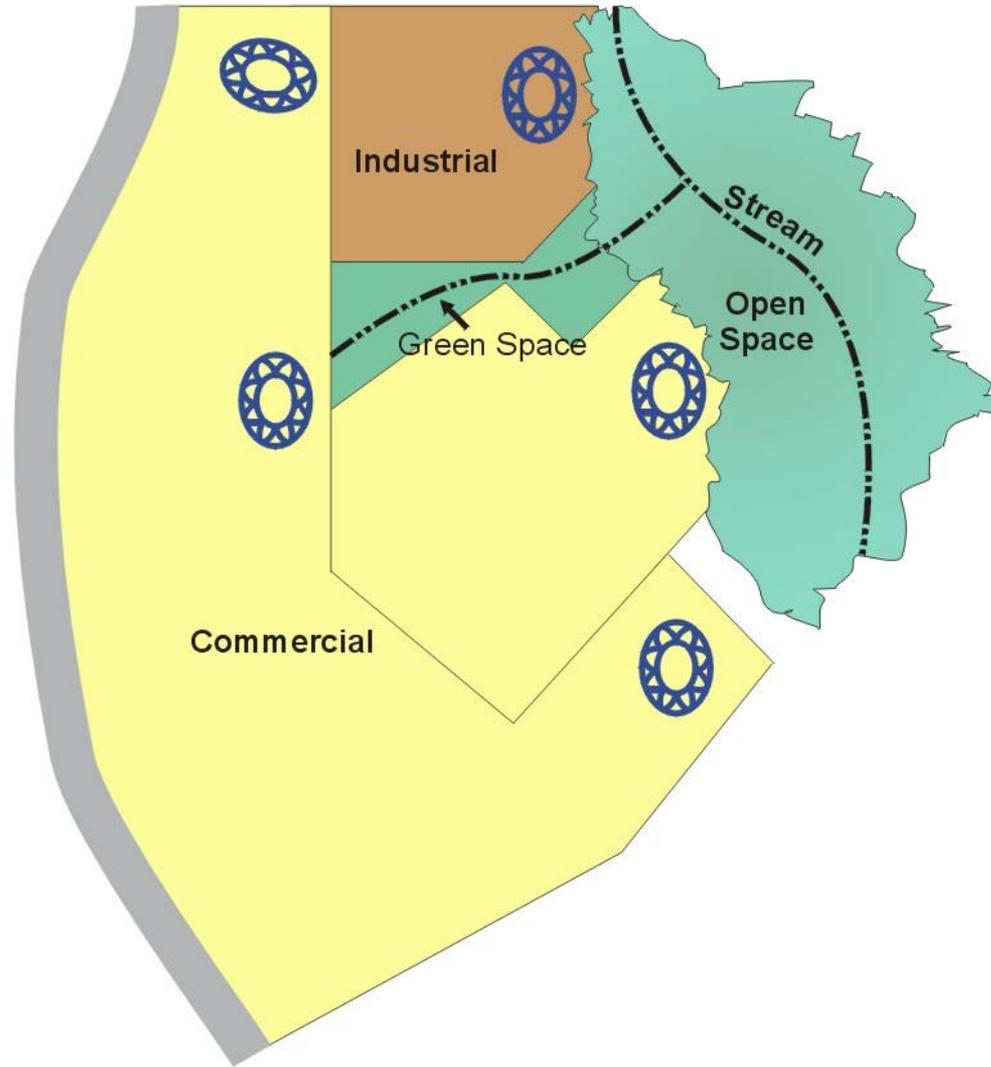
# *Basic LID Principles*

- 1.) **Conserve Natural Areas**
- 2.) Minimize of Development Impacts
- 3.) Maintain Site Runoff Rate
- 4.) Use Integrated Management Practices
- 5.) Implement Pollution Prevention and Proper Maintenance



**Traditional Master Plan**

- Uncoordinated BMP's
- Isolation of Resouces
- Large Impervious Areas

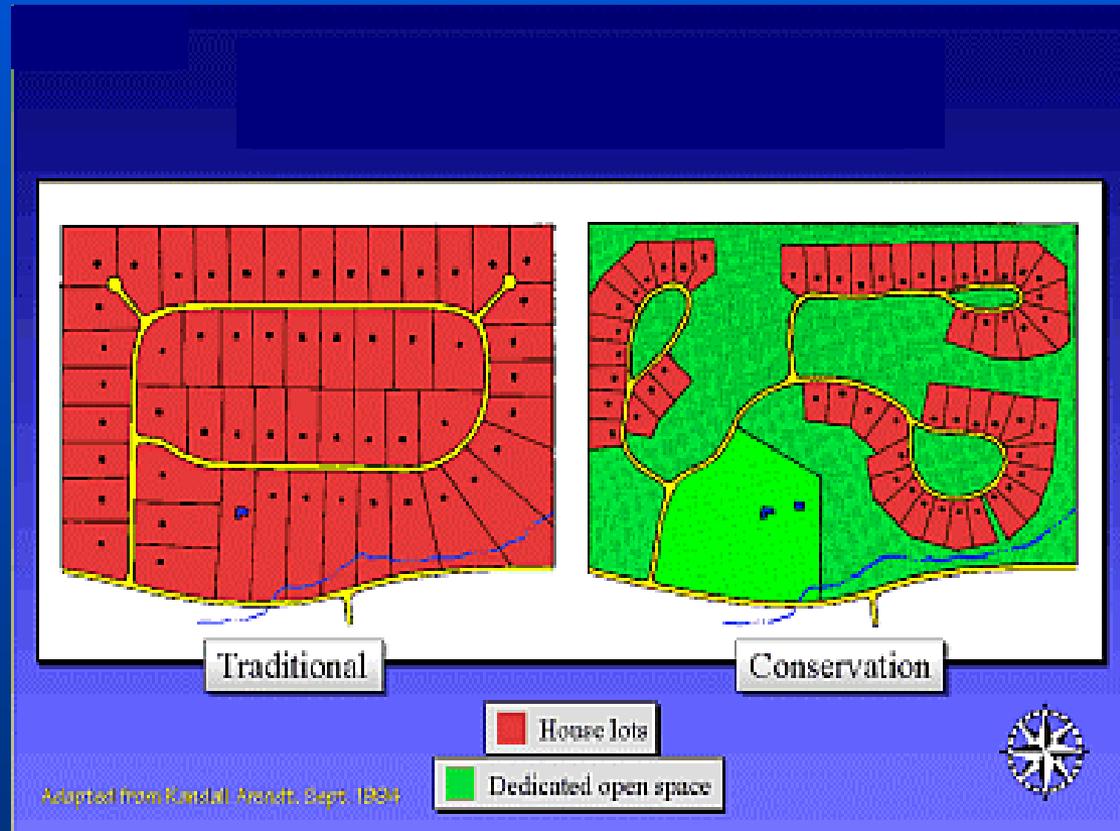


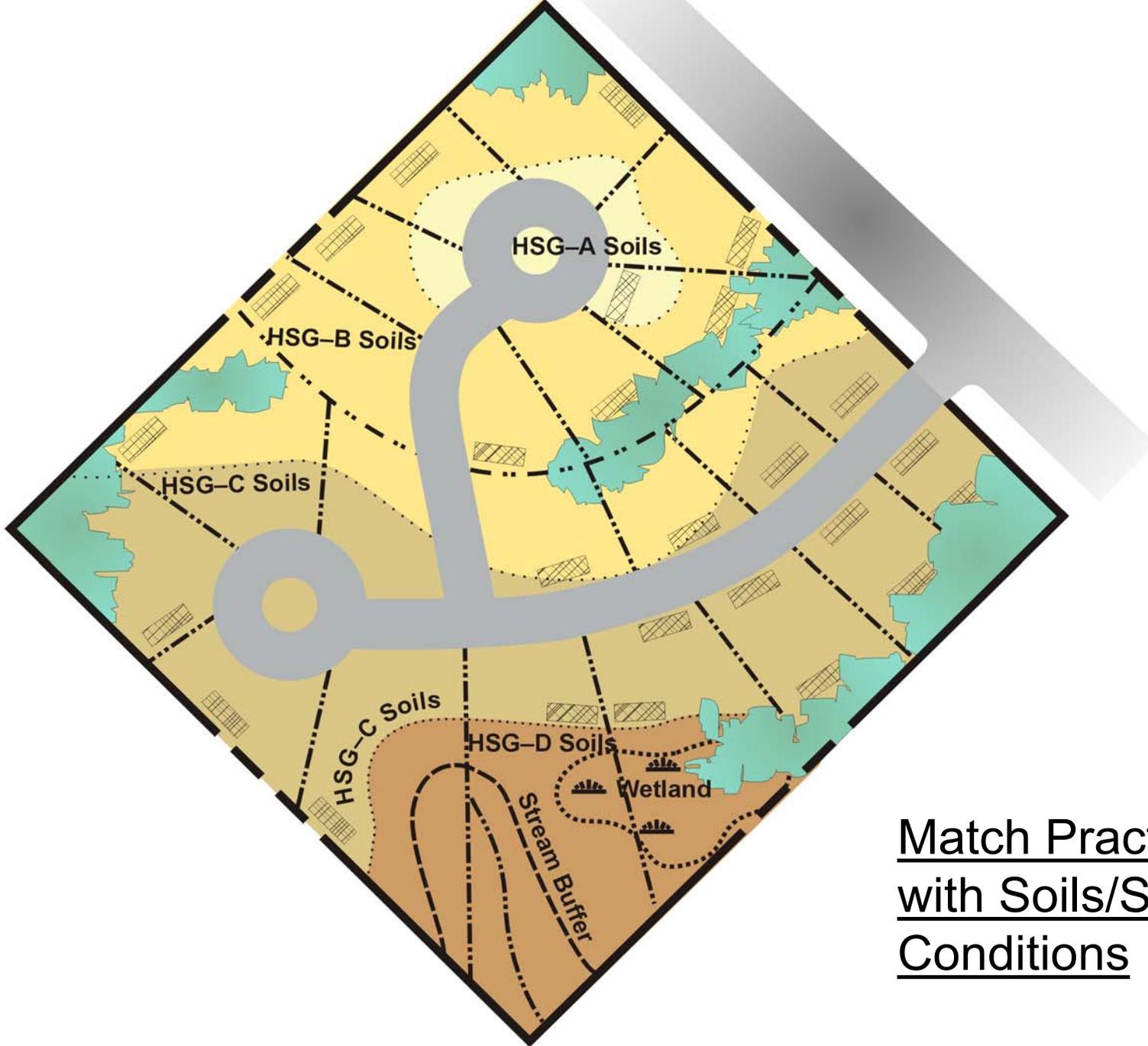
## Traditional SWM Approaches

# 1. Conservation Plans

## Regulations

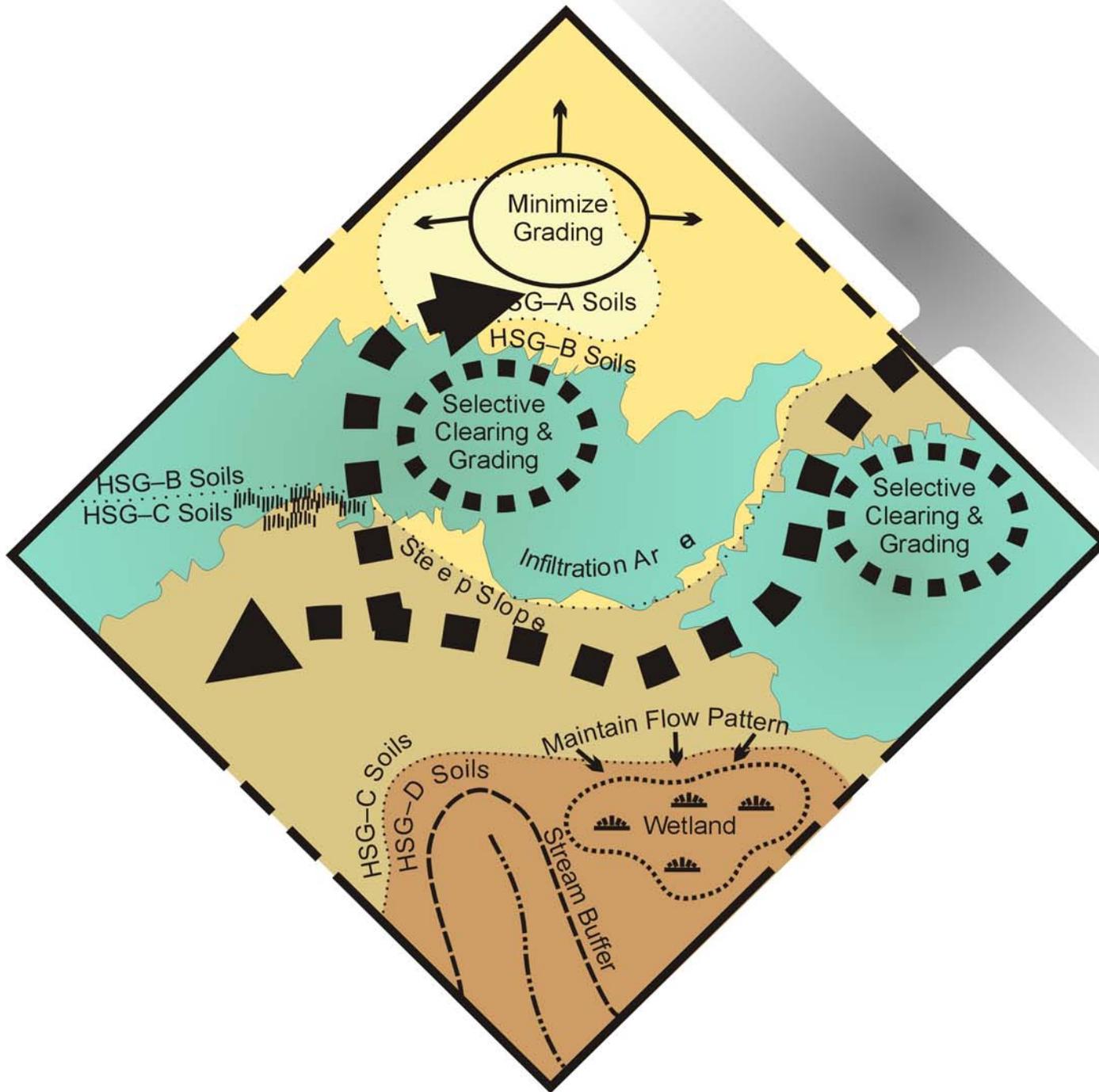
- Local Watershed Plans
- Conservation
  - Forest
  - Streams
  - Wetlands
  - Slopes
  - Buffers
  - Special Areas



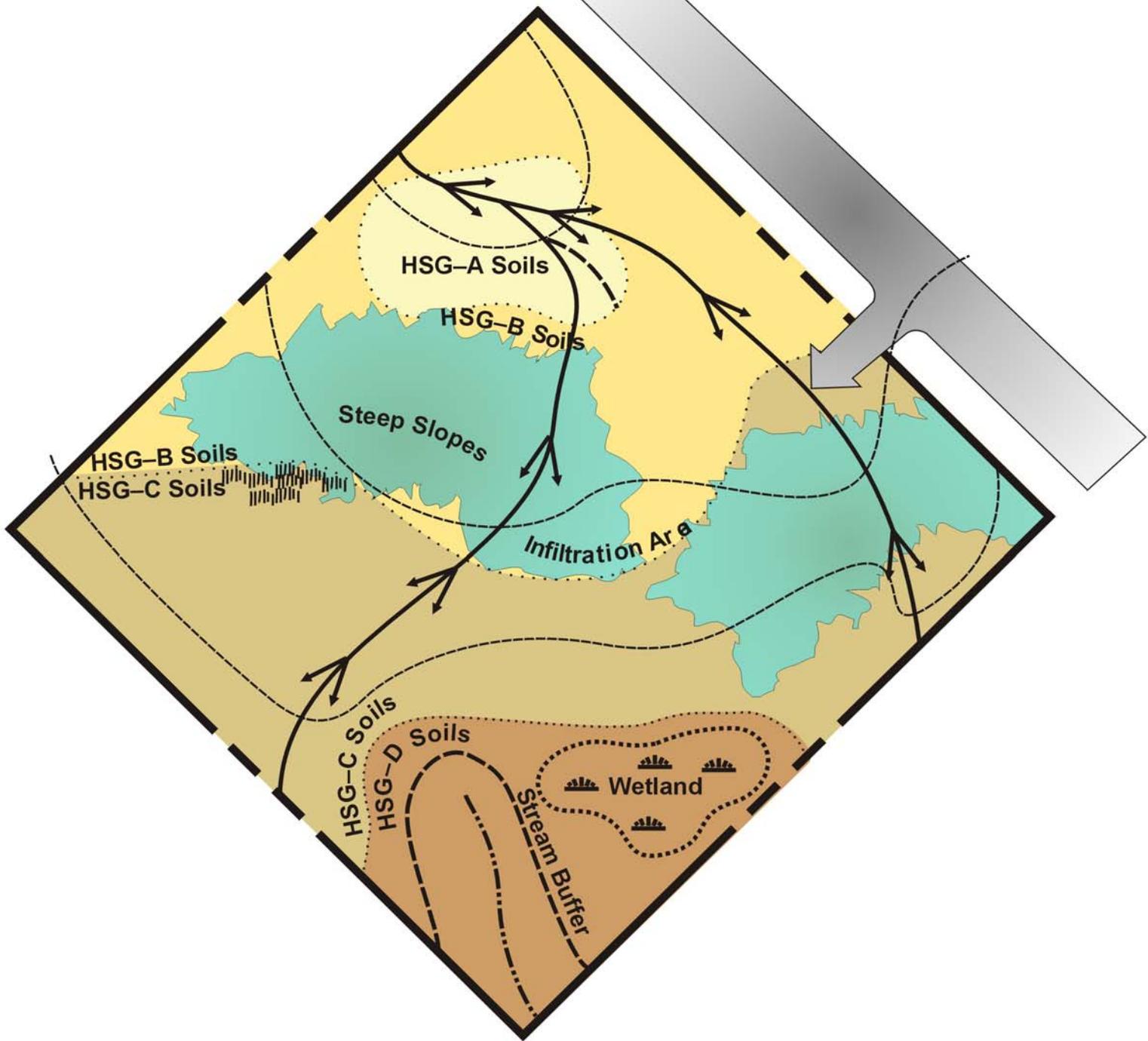


Match Practice  
with Soils/Site  
Conditions

**Low-impact Development Design**

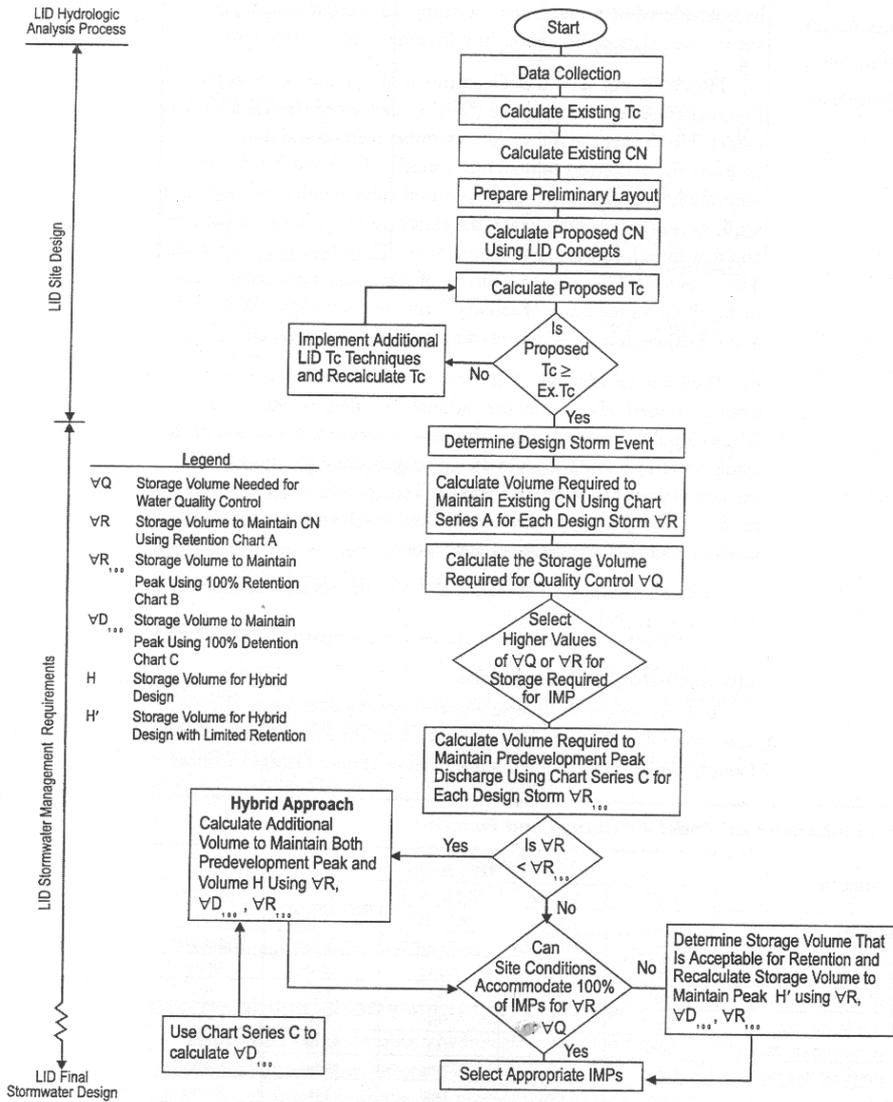


**Low-Impact Development Design Strategies**



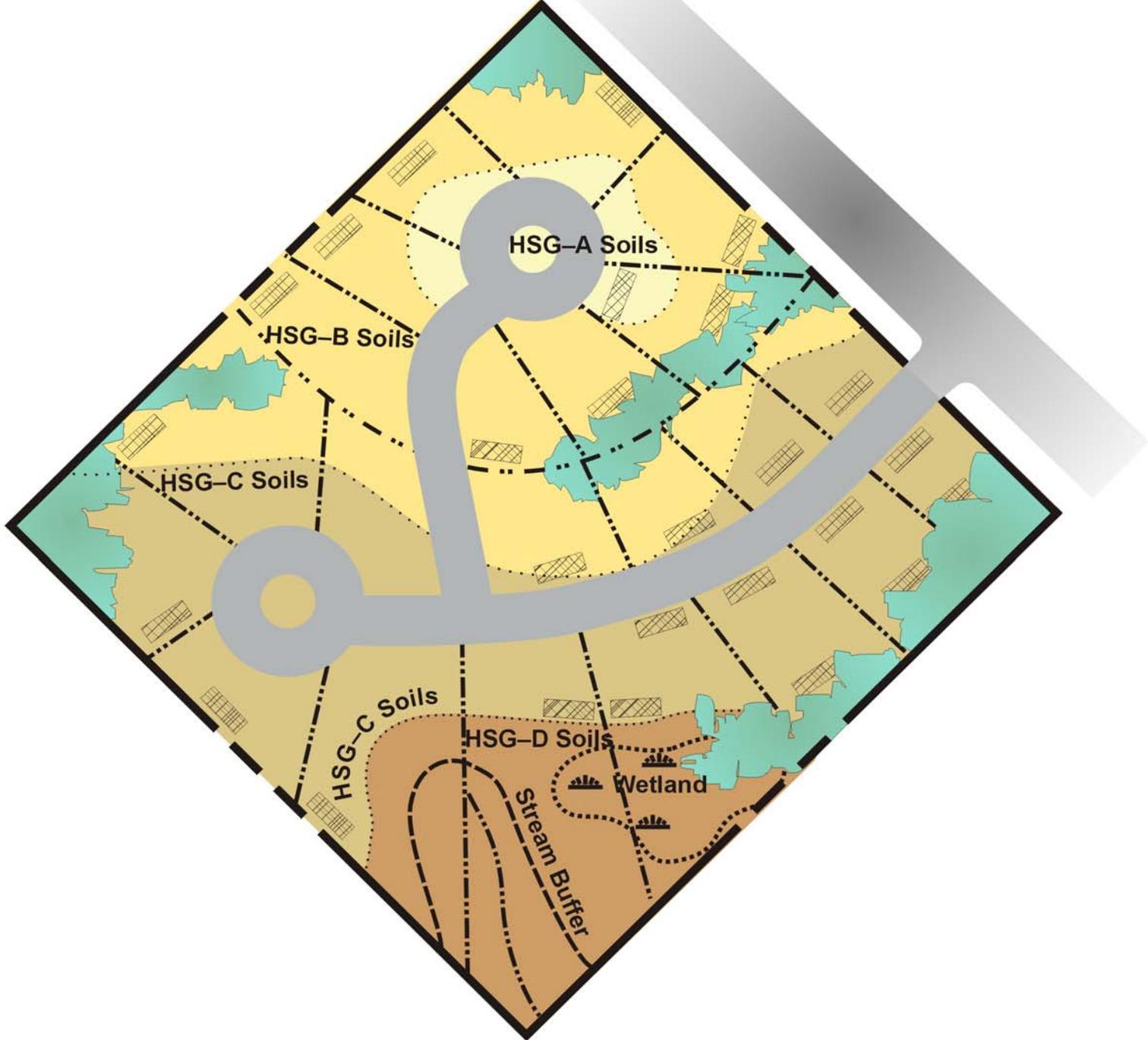
**Low-impact Development Design Analysis**

### LID Hydrologic Analysis Procedure



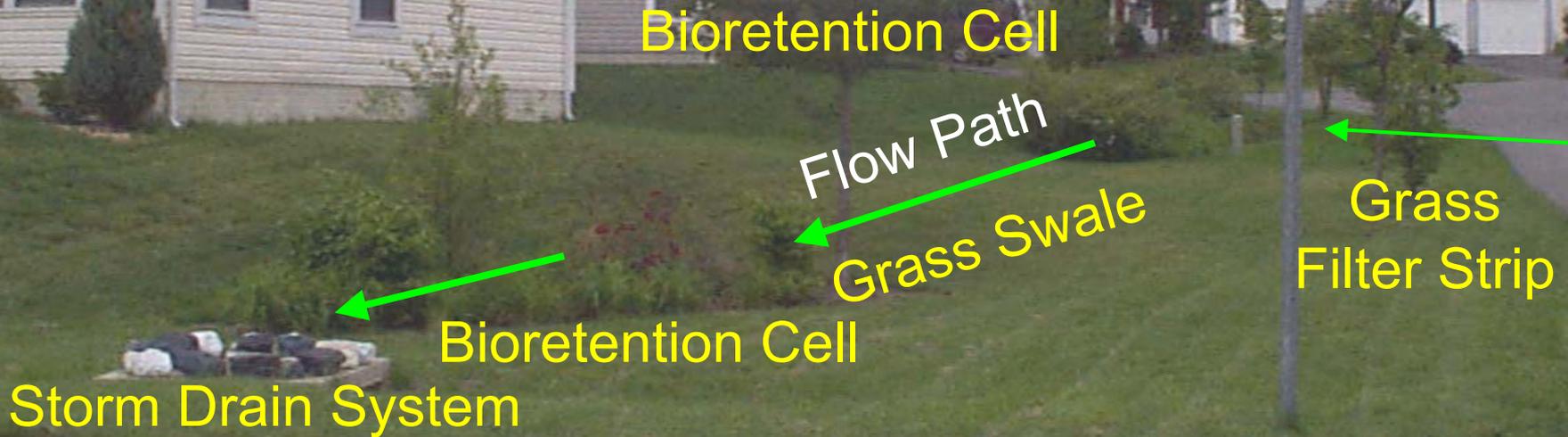
# LID HYDROLOGIC ANALYSIS PROCEDURES

Figure 3-7. Prince George's County, Maryland, example of low-impact development analysis procedure (Prince George's County, 1997)



**Low-impact Development Design**

# Rain Garden Treatment Train Approach



Particle Size Grading	Treatment Measures		Hydraulic Loading $Q_{des}/A_{facility}$
Gross Solids > 5000 $\mu\text{m}$	Gross Pollutant Traps	Sedimentation Basins (Wet & Dry) & Grass Swales	1,000,000 m/yr 100,000 m/yr
Coarse- to Medium-sized Particulates 5000 $\mu\text{m}$ – 125 $\mu\text{m}$		Filter Strips & Surface Flow Wetlands	50,000 m/yr 5000 m/yr
Fine Particulates 125 $\mu\text{m}$ – 10 $\mu\text{m}$		Infiltration Systems & Sub-Surface Flow Wetlands	2500 m/yr 1000 m/yr
Very Fine/Colloidal Particulates 10 $\mu\text{m}$ – 0.45 $\mu\text{m}$			500 m/yr 50 m/yr
Dissolved Particles < 0.45 $\mu\text{m}$			10 m/yr

Courtesy Wong, 2001

# Treatment Train Approach

## Benefits

1. Pollution Prevention

2. Minimize

- Infiltration / Retention

- Filtration / Use (BMP's)

- Evaporation

100% Load

20%

70%

60%

70%

10%

Resultant Load

4%

## Projected Pollutant Reductions

### Example

P lbs./ac./year

Forest 0.18

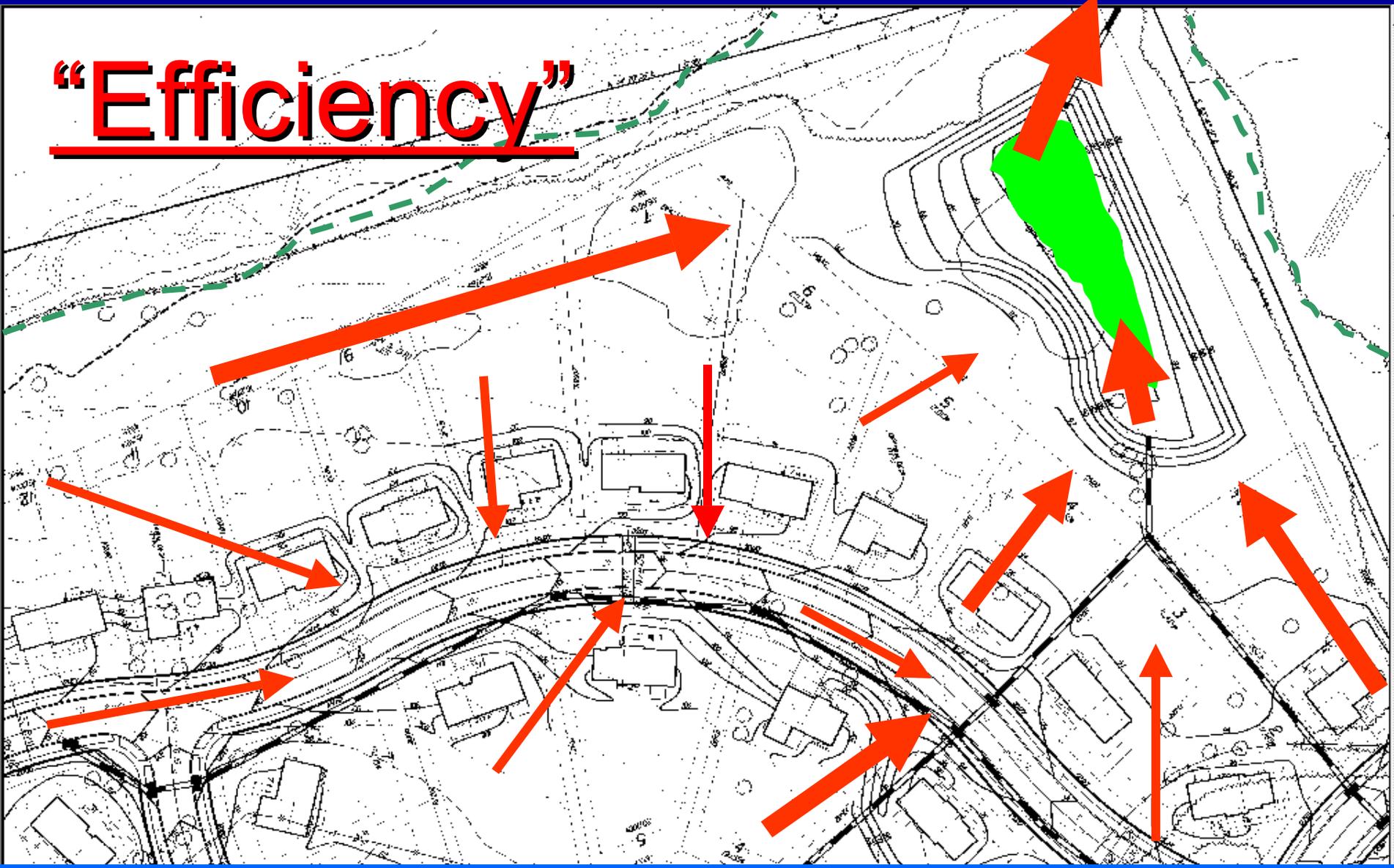
NC / LID

Suburban 0.58 /  
0.023

Urban 1.82 /  
0.073

# Conventional Pipe and Pond Centralized Control

“Efficiency”



# LID Uniform Distribution of Micro Controls



# LID Techniques and Objectives

## Low-Impact Development Technique

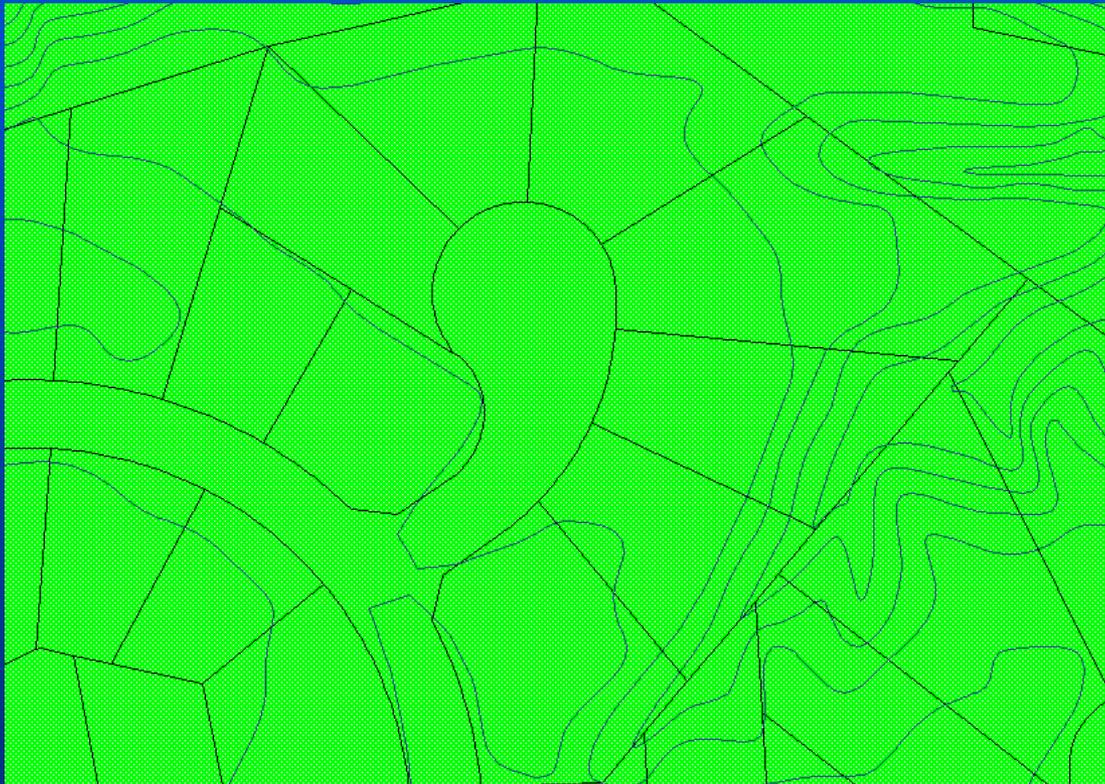
Low Impact Development Objective	Flatten Slope	Increase Flow Path	Increase Sheet Flow	Increase Roughness	Minimize Disturbance	Larger Swales	Flatten Slopes on Swales	Infiltration Swales	Vegetative Filter Strips	Constricted Pipes	Disconnected Impervious Areas	Reduce Curb and Gutter	Rain Barrels	Rooftop Storage	Bioretention	Re-Vegetation	Vegetation Preservation
Increase Time of Concentration	X	X	X	X					X	X	X	X	X	X	X		
Increase Detention Time							X			X			X	X			
Increase Storage						X		X	X						X	X	X
Lower Post Development CN					X						X				X	X	X

# Maintain Time of Concentration (T<sub>c</sub>)

## Low-Impact Development Technique

Low Impact Development objective to Maintain Time of Concentration (T <sub>c</sub> )	Balance cut and fill on lot.	Network Smaller Swales	Clusters of Trees and Shrubs in Flow Path	Provide Tree Conservation on Lots	Eliminate Storm Drain Pipes	Disconnect Impervious Areas	Save Trees in Smaller Clusters	Terrace Yards	Drain from House and then Reduce Grades
Minimize Disturbance	X		X	X	X	X	X	X	
Flatten Grades		X			X			X	X
Reduce Height of Slopes					X			X	X
Increase Flow Path (Divert and Redirect)		X	X		X	X	X		X
Increase Roughness “n”			X	X	X	X	X	X	

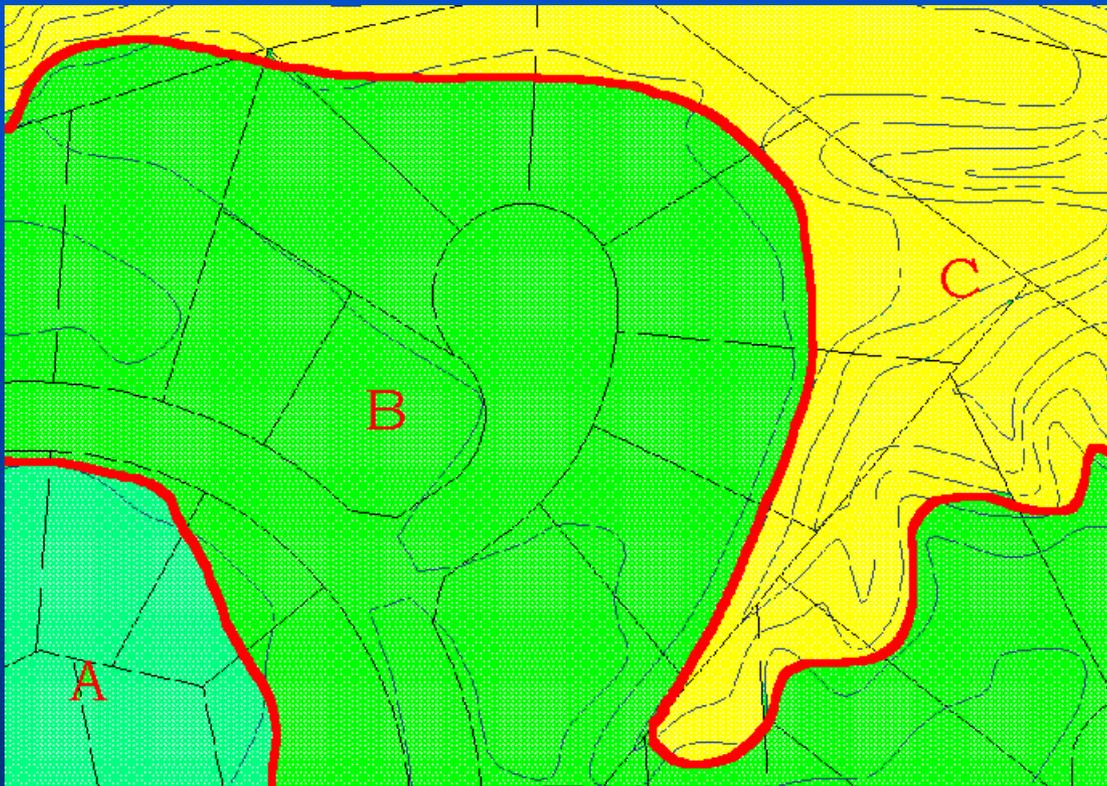
# *Pre-Development Conditions*



## Woodland Attributes

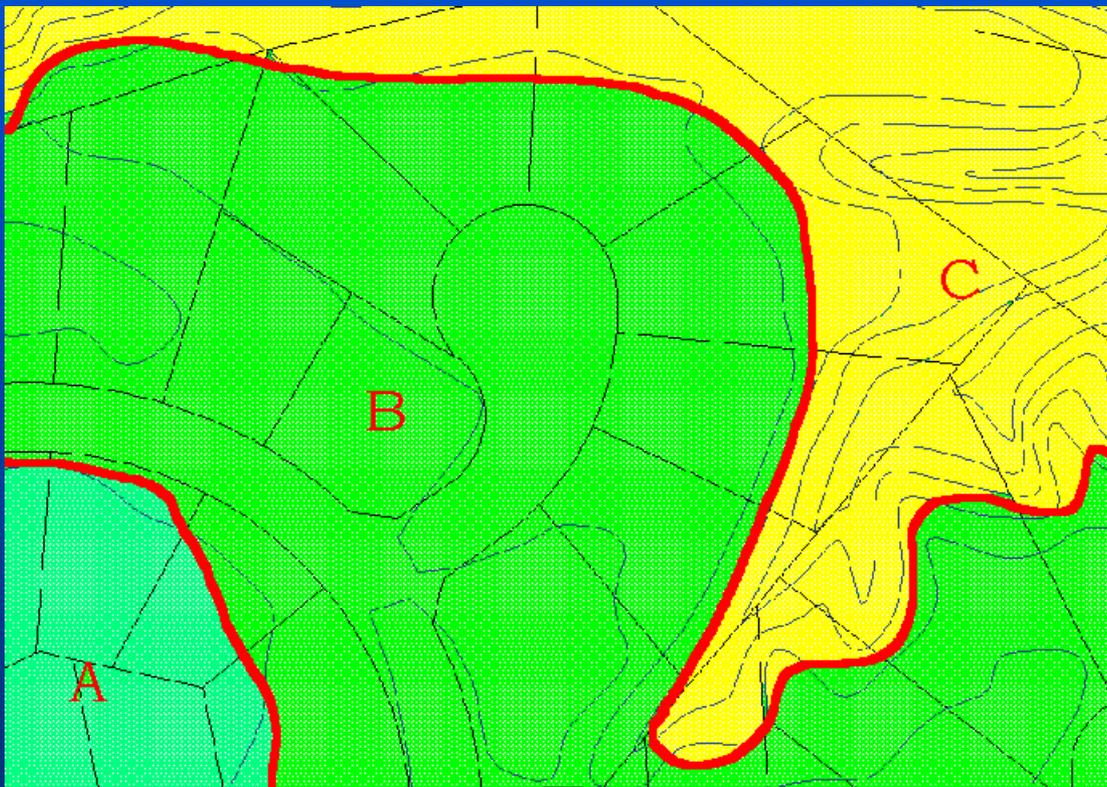
- Runoff amounts low and delayed
- Stable hydrology
- Habitat undisturbed
- CN- woods in good cond

# Soils Map Analysis



## Hydrologic Soils Groups

- D soils - CN = 77
- C soils - CN = 70
- B soils - CN = 55
- A soils - CN = 30



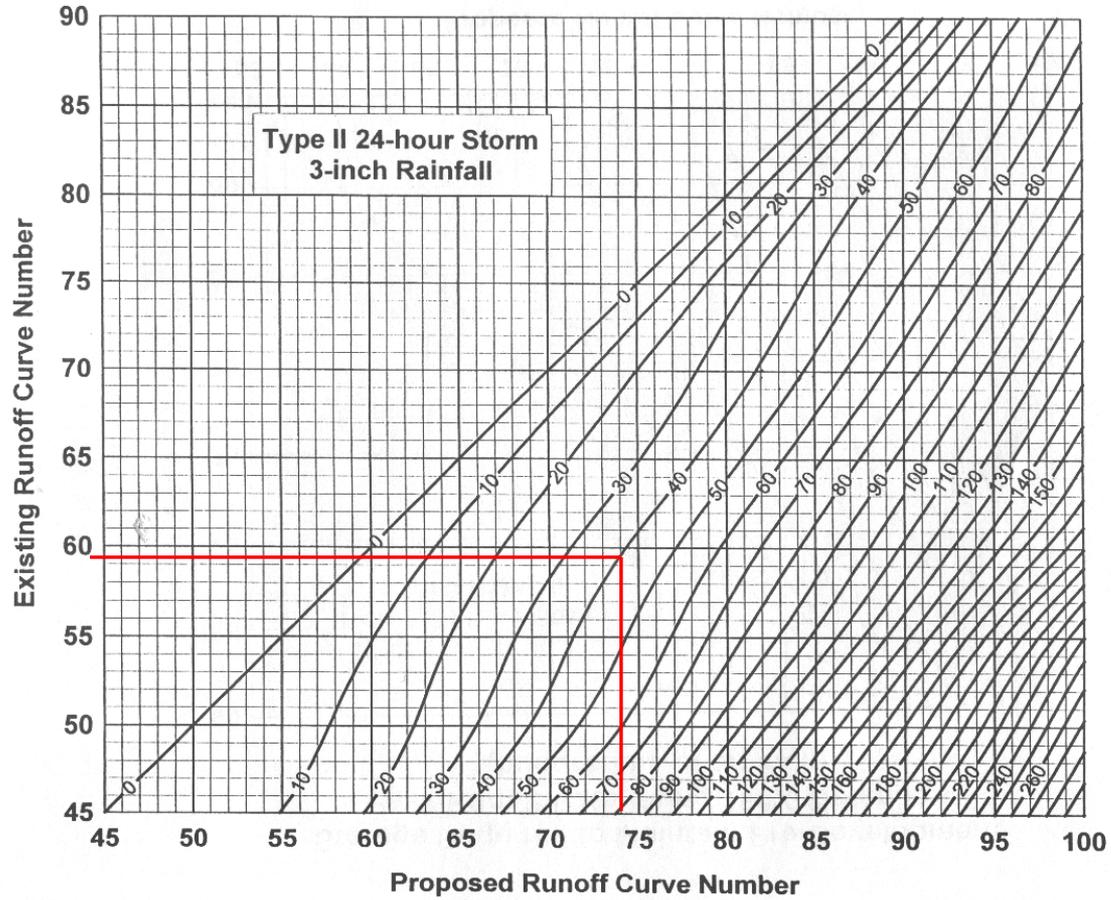
Given:

- 50 acre tract
- Zoned 1/2 acre residential
- Environmental constraints present (wetlands, steep slopes, tree conservation)

#### Conventional Calculations

25% of site C soils = 875  
58% of site B soils = 1595  
17% of site A soils = 255  
weighted CN = **54.5**

Storage Required to Maintain Pre-Development  
Peak Runoff Using 100% Detention  
(hundredths of an inch)



# *Developed Conditions- Conventional SWM Design*



## Conventional SWM Design Concepts

- Pipe and pond conveyance system
- Connected flowpaths
- Mass grade to one collection point

# Determining CN Values



## Conventional Calculations

25% of site C soils = 1000

58% of site B soils = 2030

17% of site A soils = 459

From TR55 (table 2-2a:

weighted CN = **69.8**

# *Developed Condition- Conventional SWM Design*



Stormdrain  
Calculations

$$Q_{10} = C I_{10} A$$

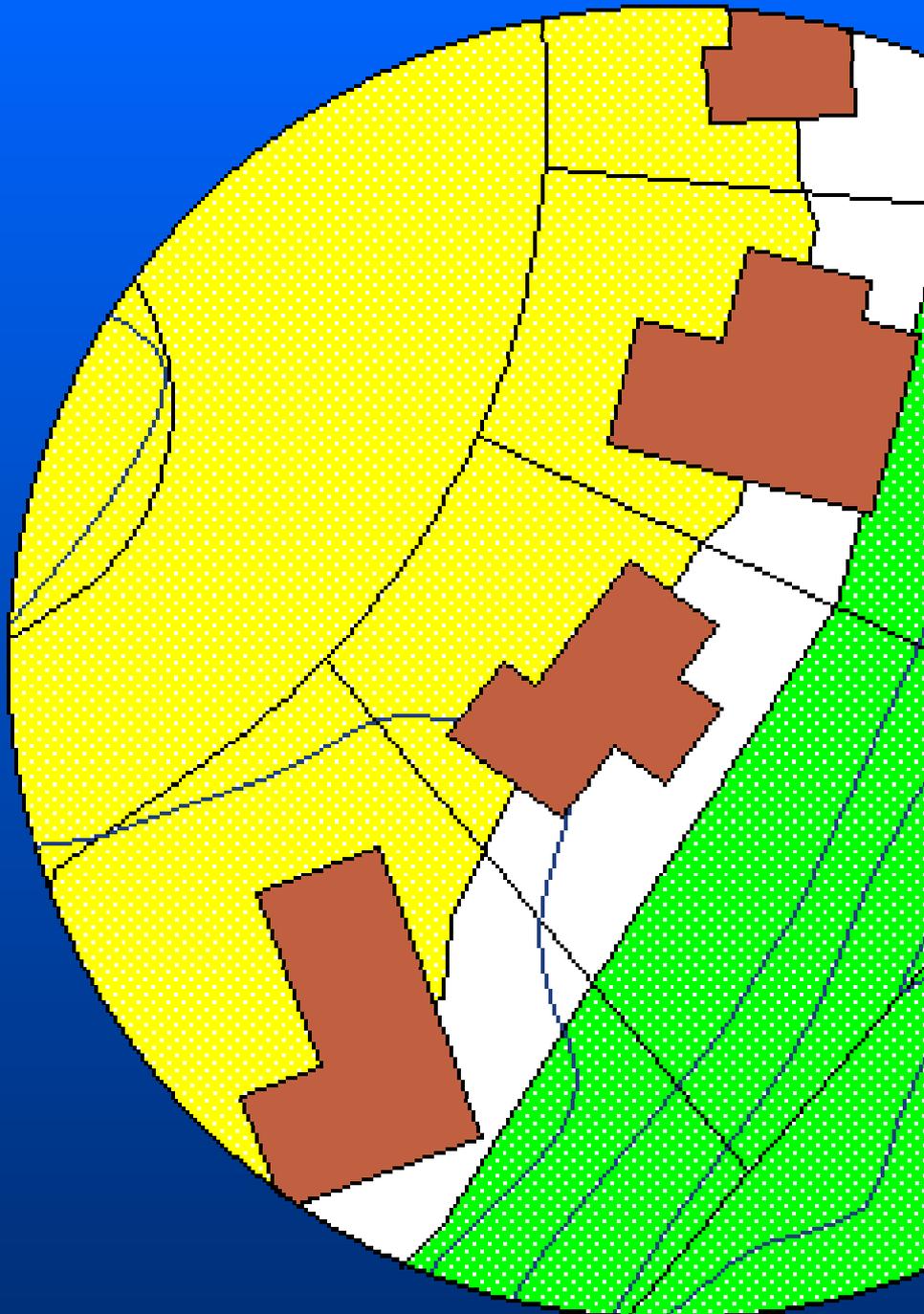
$$Q_{10} = .38 * 5.88 * 2$$

$$Q_{10} = 4.47\text{cfs}$$

$$DA = 1.9\text{ac}$$

# *Exploded View of Lot*





Closer look at lot reveals that the density is lower than typical 1/2 acre zoning used in TR55  
 CN values (20% imperv)

In this case:

30% of woods are preserved  
 Average impervious area = 15%

Developed Condition CN =

Impervious Connected =  
 5% - 98

Impervious Unconnected = 10% 98

Open Space (good cond.) = 55% 61

Woods (good cond) = 30% 63

$735 + 1373 + 945 = 3053$

Custom LID CN  
 weighted CN = **62**

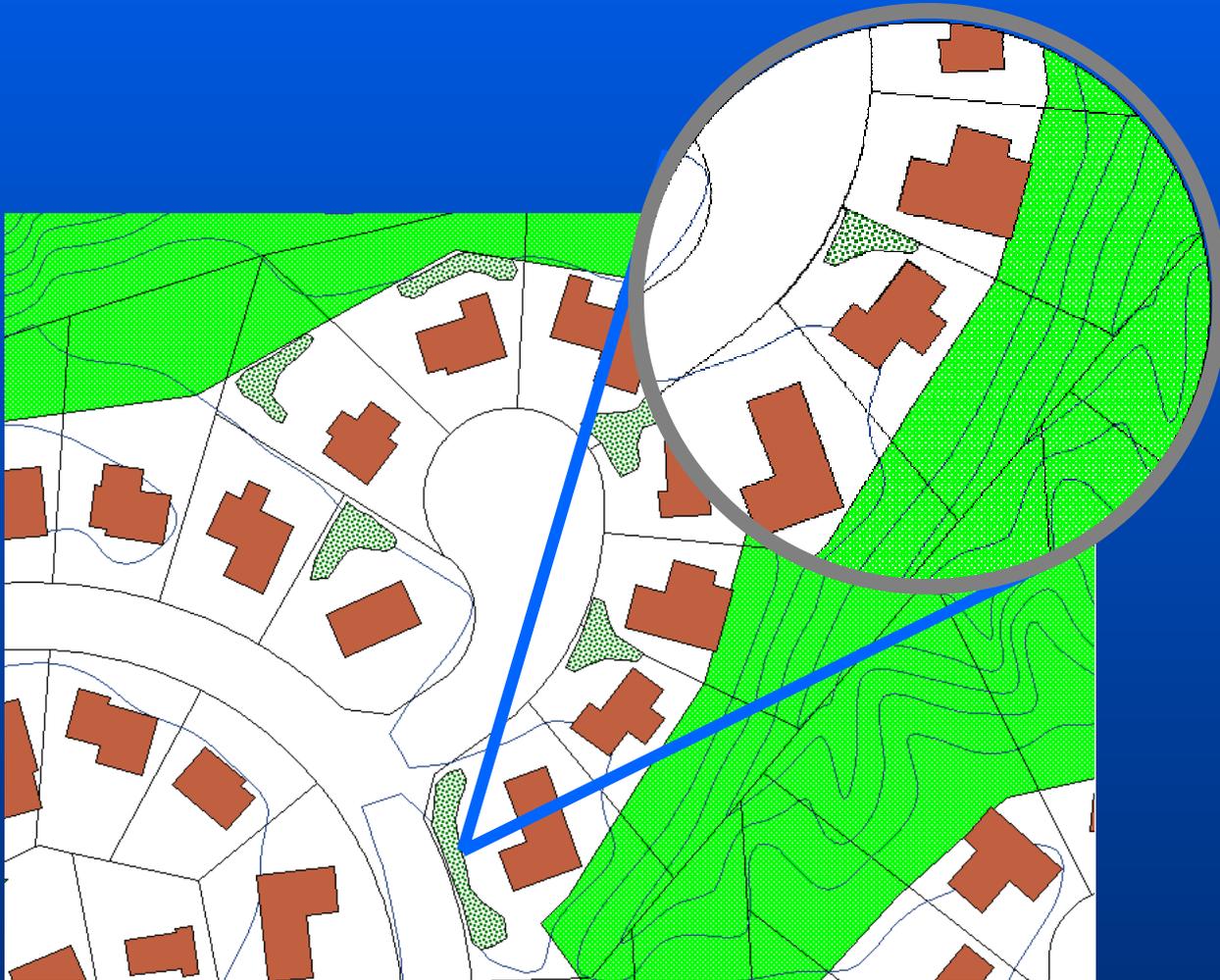
Site has < 30% imperv area.  
 Composite CN = **61**

# *LID Post Development Conditions*



## LID Components

- On-lot SWM BMP's
- Multifunctional landscaping integration
- Open-section roadways
- Disconnected flowpaths
- Grading refinement



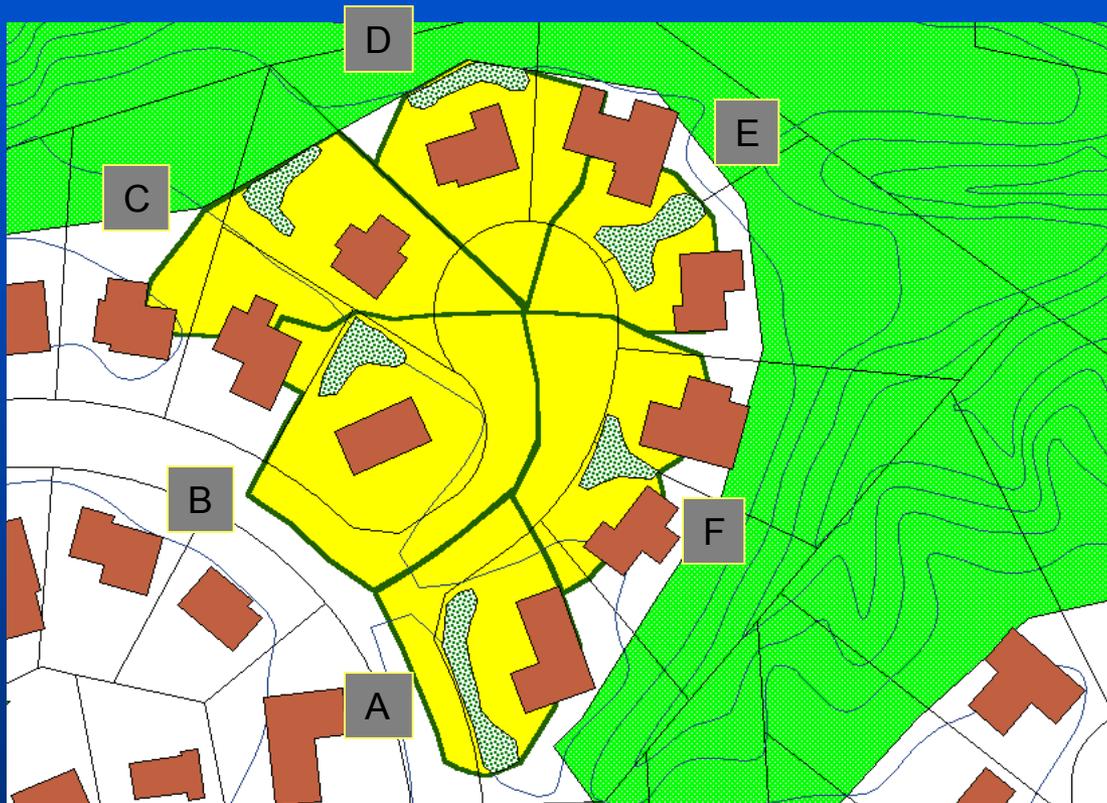
# *LID Post Development w/ Drainage Divides*



## LID Site Layout Concepts

- Pre-existing drainage divides preserved
- No net runoff
- Storm drainage infrastructure reduced
- Development potential maintained

# Post Development Peak Flow- LID SWM Integration



Peak Flow Rates\*:

A = 1.18cfs

B = 0.65cfs

C = 0.39cfs

D = 0.41cfs

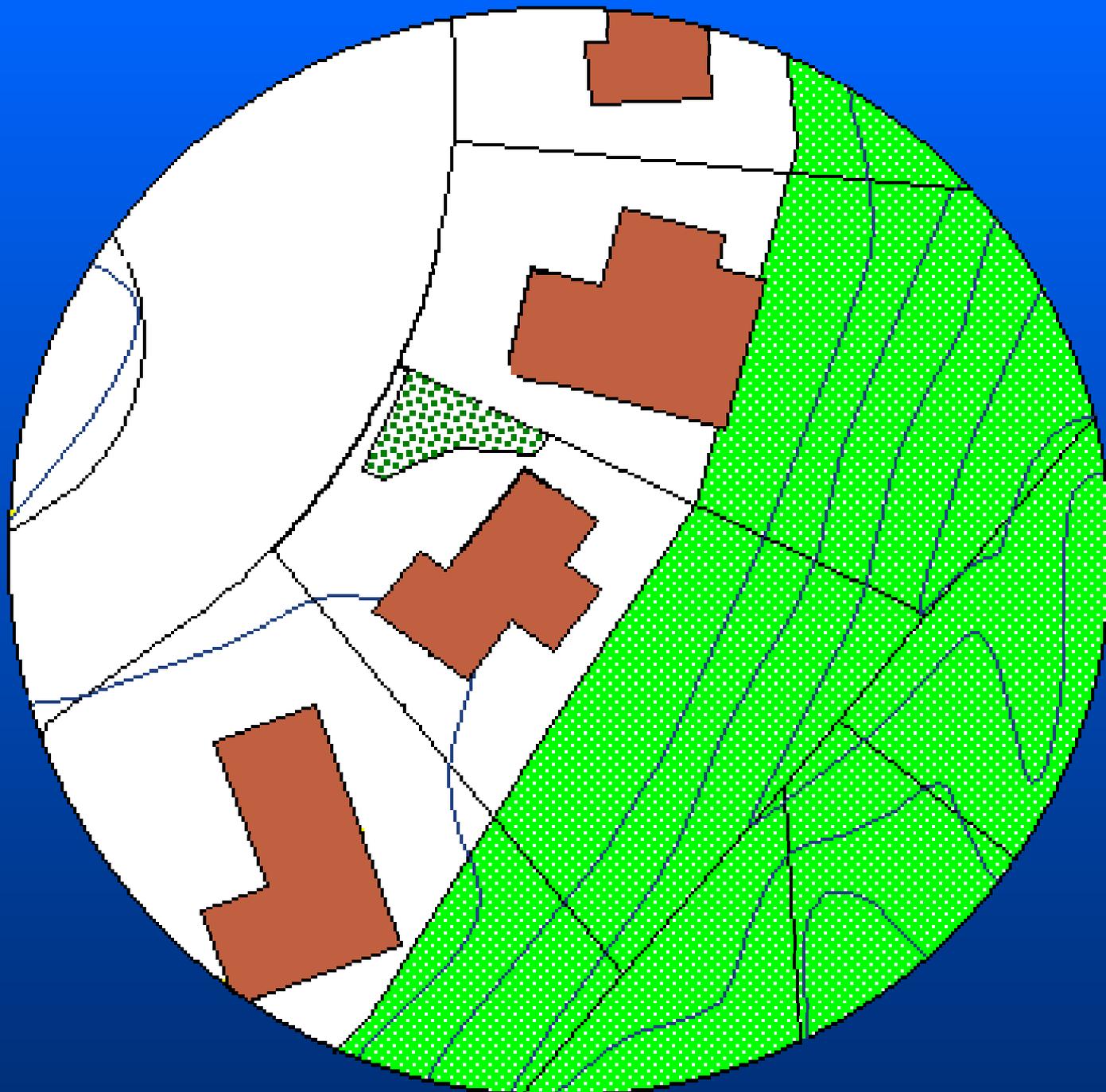
E = 0.45cfs

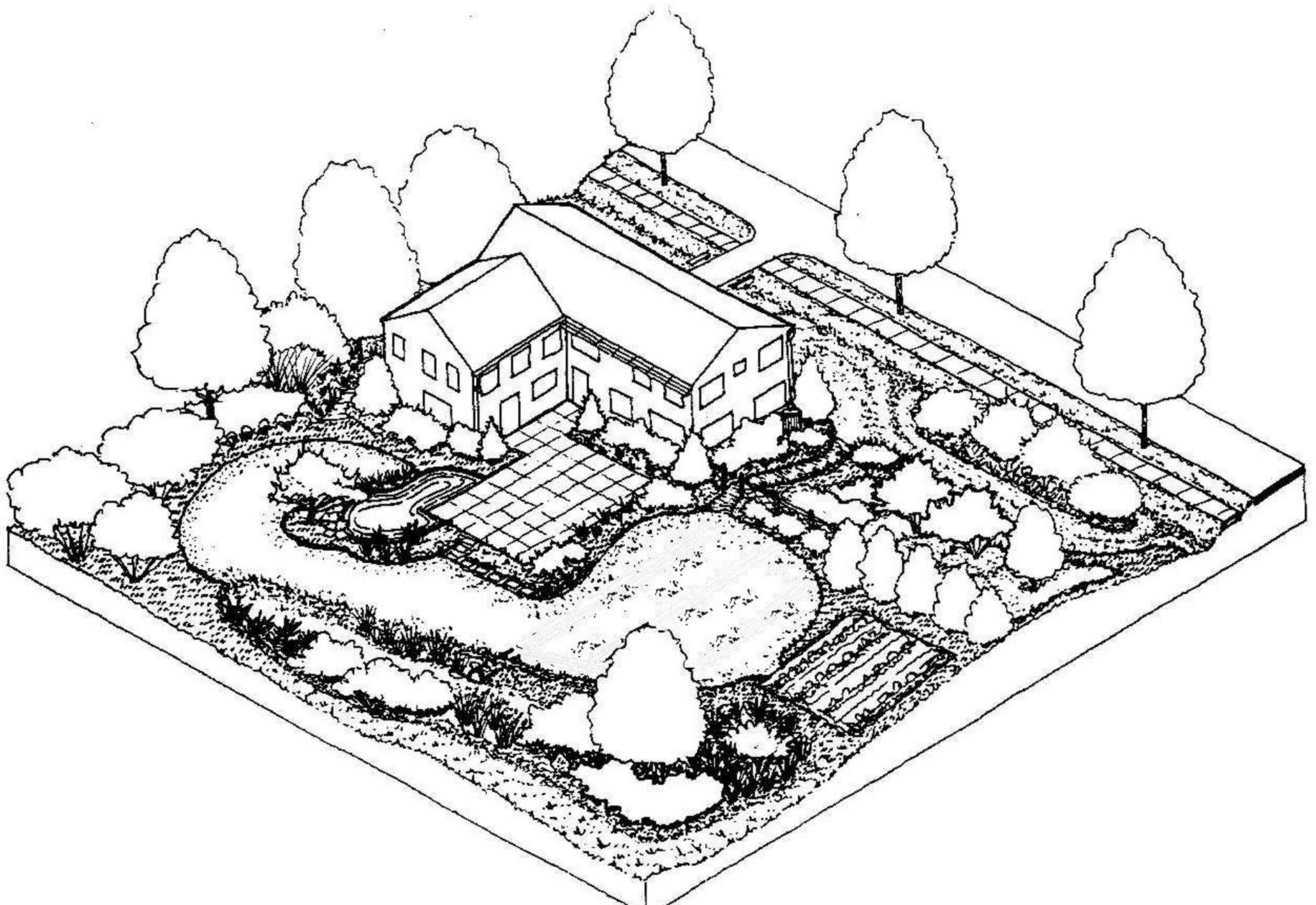
F = 0.45cfs

Total = 4.09cfs

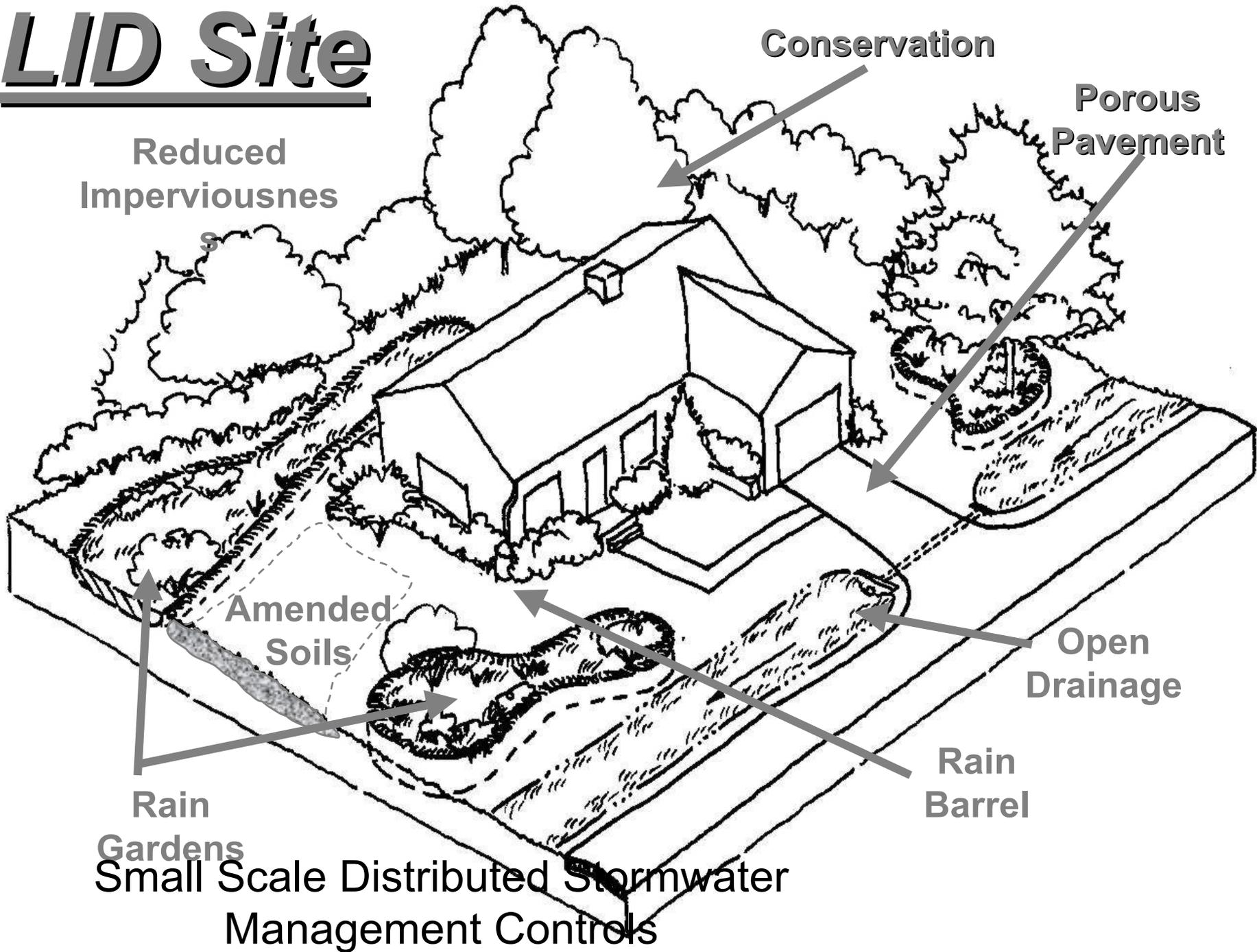
DA = 2.47ac

\* No net Runoff- All runoff volume is contained in the bioretention facilities





# LID Site





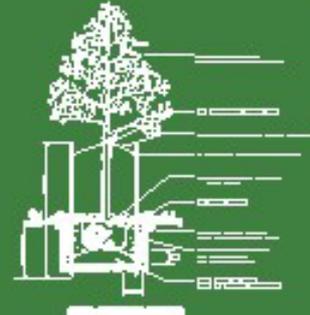
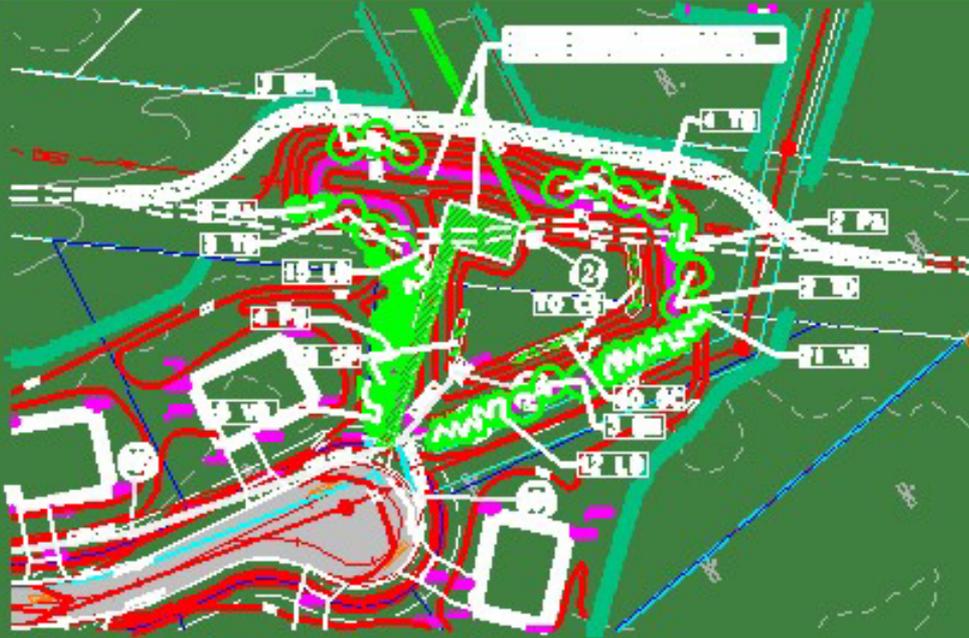
# Landscape Walls in Swales



TYPICAL TIMBER WALL  
FOR FLOW CONTROL

TIMBER WALL PLAN DETAIL

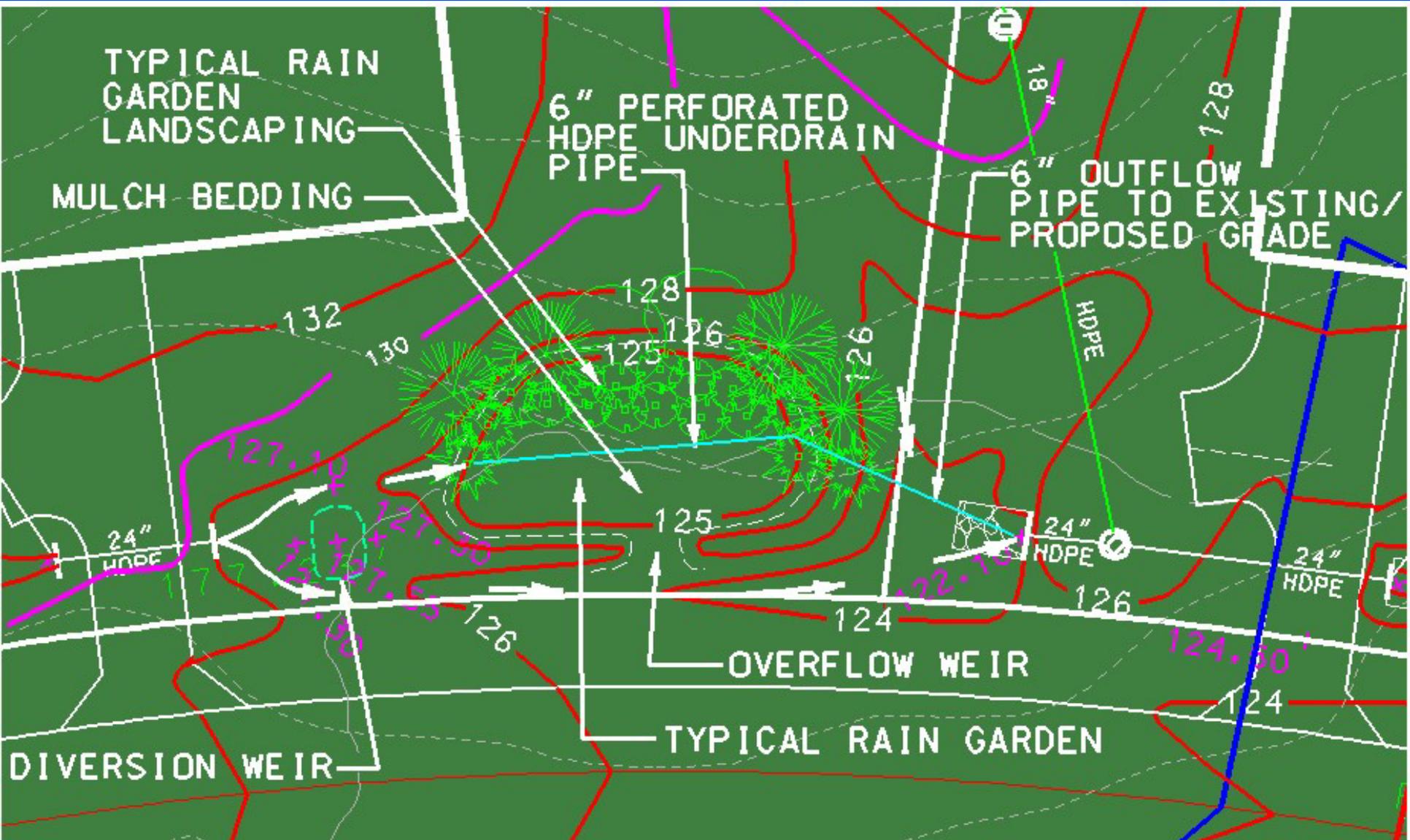
NOT TO SCALE



- 1. 12" DBH
- 2. 18" DBH
- 3. 24" DBH
- 4. 30" DBH
- 5. 36" DBH
- 6. 42" DBH
- 7. 48" DBH
- 8. 54" DBH
- 9. 60" DBH
- 10. 66" DBH
- 11. 72" DBH
- 12. 78" DBH
- 13. 84" DBH
- 14. 90" DBH
- 15. 96" DBH
- 16. 102" DBH
- 17. 108" DBH
- 18. 114" DBH
- 19. 120" DBH
- 20. 126" DBH
- 21. 132" DBH
- 22. 138" DBH
- 23. 144" DBH
- 24. 150" DBH
- 25. 156" DBH
- 26. 162" DBH
- 27. 168" DBH
- 28. 174" DBH
- 29. 180" DBH
- 30. 186" DBH
- 31. 192" DBH
- 32. 198" DBH
- 33. 204" DBH
- 34. 210" DBH
- 35. 216" DBH
- 36. 222" DBH
- 37. 228" DBH
- 38. 234" DBH
- 39. 240" DBH
- 40. 246" DBH
- 41. 252" DBH
- 42. 258" DBH
- 43. 264" DBH
- 44. 270" DBH
- 45. 276" DBH
- 46. 282" DBH
- 47. 288" DBH
- 48. 294" DBH
- 49. 300" DBH
- 50. 306" DBH
- 51. 312" DBH
- 52. 318" DBH
- 53. 324" DBH
- 54. 330" DBH
- 55. 336" DBH
- 56. 342" DBH
- 57. 348" DBH
- 58. 354" DBH
- 59. 360" DBH
- 60. 366" DBH
- 61. 372" DBH
- 62. 378" DBH
- 63. 384" DBH
- 64. 390" DBH
- 65. 396" DBH
- 66. 402" DBH
- 67. 408" DBH
- 68. 414" DBH
- 69. 420" DBH
- 70. 426" DBH
- 71. 432" DBH
- 72. 438" DBH
- 73. 444" DBH
- 74. 450" DBH
- 75. 456" DBH
- 76. 462" DBH
- 77. 468" DBH
- 78. 474" DBH
- 79. 480" DBH
- 80. 486" DBH
- 81. 492" DBH
- 82. 498" DBH
- 83. 504" DBH
- 84. 510" DBH
- 85. 516" DBH
- 86. 522" DBH
- 87. 528" DBH
- 88. 534" DBH
- 89. 540" DBH
- 90. 546" DBH
- 91. 552" DBH
- 92. 558" DBH
- 93. 564" DBH
- 94. 570" DBH
- 95. 576" DBH
- 96. 582" DBH
- 97. 588" DBH
- 98. 594" DBH
- 99. 600" DBH
- 100. 606" DBH
- 101. 612" DBH
- 102. 618" DBH
- 103. 624" DBH
- 104. 630" DBH
- 105. 636" DBH
- 106. 642" DBH
- 107. 648" DBH
- 108. 654" DBH
- 109. 660" DBH
- 110. 666" DBH
- 111. 672" DBH
- 112. 678" DBH
- 113. 684" DBH
- 114. 690" DBH
- 115. 696" DBH
- 116. 702" DBH
- 117. 708" DBH
- 118. 714" DBH
- 119. 720" DBH
- 120. 726" DBH
- 121. 732" DBH
- 122. 738" DBH
- 123. 744" DBH
- 124. 750" DBH
- 125. 756" DBH
- 126. 762" DBH
- 127. 768" DBH
- 128. 774" DBH
- 129. 780" DBH
- 130. 786" DBH
- 131. 792" DBH
- 132. 798" DBH
- 133. 804" DBH
- 134. 810" DBH
- 135. 816" DBH
- 136. 822" DBH
- 137. 828" DBH
- 138. 834" DBH
- 139. 840" DBH
- 140. 846" DBH
- 141. 852" DBH
- 142. 858" DBH
- 143. 864" DBH
- 144. 870" DBH
- 145. 876" DBH
- 146. 882" DBH
- 147. 888" DBH
- 148. 894" DBH
- 149. 900" DBH
- 150. 906" DBH
- 151. 912" DBH
- 152. 918" DBH
- 153. 924" DBH
- 154. 930" DBH
- 155. 936" DBH
- 156. 942" DBH
- 157. 948" DBH
- 158. 954" DBH
- 159. 960" DBH
- 160. 966" DBH
- 161. 972" DBH
- 162. 978" DBH
- 163. 984" DBH
- 164. 990" DBH
- 165. 996" DBH
- 166. 1002" DBH
- 167. 1008" DBH
- 168. 1014" DBH
- 169. 1020" DBH
- 170. 1026" DBH
- 171. 1032" DBH
- 172. 1038" DBH
- 173. 1044" DBH
- 174. 1050" DBH
- 175. 1056" DBH
- 176. 1062" DBH
- 177. 1068" DBH
- 178. 1074" DBH
- 179. 1080" DBH
- 180. 1086" DBH
- 181. 1092" DBH
- 182. 1098" DBH
- 183. 1104" DBH
- 184. 1110" DBH
- 185. 1116" DBH
- 186. 1122" DBH
- 187. 1128" DBH
- 188. 1134" DBH
- 189. 1140" DBH
- 190. 1146" DBH
- 191. 1152" DBH
- 192. 1158" DBH
- 193. 1164" DBH
- 194. 1170" DBH
- 195. 1176" DBH
- 196. 1182" DBH
- 197. 1188" DBH
- 198. 1194" DBH
- 199. 1200" DBH
- 200. 1206" DBH
- 201. 1212" DBH
- 202. 1218" DBH
- 203. 1224" DBH
- 204. 1230" DBH
- 205. 1236" DBH
- 206. 1242" DBH
- 207. 1248" DBH
- 208. 1254" DBH
- 209. 1260" DBH
- 210. 1266" DBH
- 211. 1272" DBH
- 212. 1278" DBH
- 213. 1284" DBH
- 214. 1290" DBH
- 215. 1296" DBH
- 216. 1302" DBH
- 217. 1308" DBH
- 218. 1314" DBH
- 219. 1320" DBH
- 220. 1326" DBH
- 221. 1332" DBH
- 222. 1338" DBH
- 223. 1344" DBH
- 224. 1350" DBH
- 225. 1356" DBH
- 226. 1362" DBH
- 227. 1368" DBH
- 228. 1374" DBH
- 229. 1380" DBH
- 230. 1386" DBH
- 231. 1392" DBH
- 232. 1398" DBH
- 233. 1404" DBH
- 234. 1410" DBH
- 235. 1416" DBH
- 236. 1422" DBH
- 237. 1428" DBH
- 238. 1434" DBH
- 239. 1440" DBH
- 240. 1446" DBH
- 241. 1452" DBH
- 242. 1458" DBH
- 243. 1464" DBH
- 244. 1470" DBH
- 245. 1476" DBH
- 246. 1482" DBH
- 247. 1488" DBH
- 248. 1494" DBH
- 249. 1500" DBH
- 250. 1506" DBH
- 251. 1512" DBH
- 252. 1518" DBH
- 253. 1524" DBH
- 254. 1530" DBH
- 255. 1536" DBH
- 256. 1542" DBH
- 257. 1548" DBH
- 258. 1554" DBH
- 259. 1560" DBH
- 260. 1566" DBH
- 261. 1572" DBH
- 262. 1578" DBH
- 263. 1584" DBH
- 264. 1590" DBH
- 265. 1596" DBH
- 266. 1602" DBH
- 267. 1608" DBH
- 268. 1614" DBH
- 269. 1620" DBH
- 270. 1626" DBH
- 271. 1632" DBH
- 272. 1638" DBH
- 273. 1644" DBH
- 274. 1650" DBH
- 275. 1656" DBH
- 276. 1662" DBH
- 277. 1668" DBH
- 278. 1674" DBH
- 279. 1680" DBH
- 280. 1686" DBH
- 281. 1692" DBH
- 282. 1698" DBH
- 283. 1704" DBH
- 284. 1710" DBH
- 285. 1716" DBH
- 286. 1722" DBH
- 287. 1728" DBH
- 288. 1734" DBH
- 289. 1740" DBH
- 290. 1746" DBH
- 291. 1752" DBH
- 292. 1758" DBH
- 293. 1764" DBH
- 294. 1770" DBH
- 295. 1776" DBH
- 296. 1782" DBH
- 297. 1788" DBH
- 298. 1794" DBH
- 299. 1800" DBH
- 300. 1806" DBH
- 301. 1812" DBH
- 302. 1818" DBH
- 303. 1824" DBH
- 304. 1830" DBH
- 305. 1836" DBH
- 306. 1842" DBH
- 307. 1848" DBH
- 308. 1854" DBH
- 309. 1860" DBH
- 310. 1866" DBH
- 311. 1872" DBH
- 312. 1878" DBH
- 313. 1884" DBH
- 314. 1890" DBH
- 315. 1896" DBH
- 316. 1902" DBH
- 317. 1908" DBH
- 318. 1914" DBH
- 319. 1920" DBH
- 320. 1926" DBH
- 321. 1932" DBH
- 322. 1938" DBH
- 323. 1944" DBH
- 324. 1950" DBH
- 325. 1956" DBH
- 326. 1962" DBH
- 327. 1968" DBH
- 328. 1974" DBH
- 329. 1980" DBH
- 330. 1986" DBH
- 331. 1992" DBH
- 332. 1998" DBH
- 333. 2004" DBH
- 334. 2010" DBH
- 335. 2016" DBH
- 336. 2022" DBH
- 337. 2028" DBH
- 338. 2034" DBH
- 339. 2040" DBH
- 340. 2046" DBH
- 341. 2052" DBH
- 342. 2058" DBH
- 343. 2064" DBH
- 344. 2070" DBH
- 345. 2076" DBH
- 346. 2082" DBH
- 347. 2088" DBH
- 348. 2094" DBH
- 349. 2100" DBH
- 350. 2106" DBH
- 351. 2112" DBH
- 352. 2118" DBH
- 353. 2124" DBH
- 354. 2130" DBH
- 355. 2136" DBH
- 356. 2142" DBH
- 357. 2148" DBH
- 358. 2154" DBH
- 359. 2160" DBH
- 360. 2166" DBH
- 361. 2172" DBH
- 362. 2178" DBH
- 363. 2184" DBH
- 364. 2190" DBH
- 365. 2196" DBH
- 366. 2202" DBH
- 367. 2208" DBH
- 368. 2214" DBH
- 369. 2220" DBH
- 370. 2226" DBH
- 371. 2232" DBH
- 372. 2238" DBH
- 373. 2244" DBH
- 374. 2250" DBH
- 375. 2256" DBH
- 376. 2262" DBH
- 377. 2268" DBH
- 378. 2274" DBH
- 379. 2280" DBH
- 380. 2286" DBH
- 381. 2292" DBH
- 382. 2298" DBH
- 383. 2304" DBH
- 384. 2310" DBH
- 385. 2316" DBH
- 386. 2322" DBH
- 387. 2328" DBH
- 388. 2334" DBH
- 389. 2340" DBH
- 390. 2346" DBH
- 391. 2352" DBH
- 392. 2358" DBH
- 393. 2364" DBH
- 394. 2370" DBH
- 395. 2376" DBH
- 396. 2382" DBH
- 397. 2388" DBH
- 398. 2394" DBH
- 399. 2400" DBH
- 400. 2406" DBH
- 401. 2412" DBH
- 402. 2418" DBH
- 403. 2424" DBH
- 404. 2430" DBH
- 405. 2436" DBH
- 406. 2442" DBH
- 407. 2448" DBH
- 408. 2454" DBH
- 409. 2460" DBH
- 410. 2466" DBH
- 411. 2472" DBH
- 412. 2478" DBH
- 413. 2484" DBH
- 414. 2490" DBH
- 415. 2496" DBH
- 416. 2502" DBH
- 417. 2508" DBH
- 418. 2514" DBH
- 419. 2520" DBH
- 420. 2526" DBH
- 421. 2532" DBH
- 422. 2538" DBH
- 423. 2544" DBH
- 424. 2550" DBH
- 425. 2556" DBH
- 426. 2562" DBH
- 427. 2568" DBH
- 428. 2574" DBH
- 429. 2580" DBH
- 430. 2586" DBH
- 431. 2592" DBH
- 432. 2598" DBH
- 433. 2604" DBH
- 434. 2610" DBH
- 435. 2616" DBH
- 436. 2622" DBH
- 437. 2628" DBH
- 438. 2634" DBH
- 439. 2640" DBH
- 440. 2646" DBH
- 441. 2652" DBH
- 442. 2658" DBH
- 443. 2664" DBH
- 444. 2670" DBH
- 445. 2676" DBH
- 446. 2682" DBH
- 447. 2688" DBH
- 448. 2694" DBH
- 449. 2700" DBH
- 450. 2706" DBH
- 451. 2712" DBH
- 452. 2718" DBH
- 453. 2724" DBH
- 454. 2730" DBH
- 455. 2736" DBH
- 456. 2742" DBH
- 457. 2748" DBH
- 458. 2754" DBH
- 459. 2760" DBH
- 460. 2766" DBH
- 461. 2772" DBH
- 462. 2778" DBH
- 463. 2784" DBH
- 464. 2790" DBH
- 465. 2796" DBH
- 466. 2802" DBH
- 467. 2808" DBH
- 468. 2814" DBH
- 469. 2820" DBH
- 470. 2826" DBH
- 471. 2832" DBH
- 472. 2838" DBH
- 473. 2844" DBH
- 474. 2850" DBH
- 475. 2856" DBH
- 476. 2862" DBH
- 477. 2868" DBH
- 478. 2874" DBH
- 479. 2880" DBH
- 480. 2886" DBH
- 481. 2892" DBH
- 482. 2898" DBH
- 483. 2904" DBH
- 484. 2910" DBH
- 485. 2916" DBH
- 486. 2922" DBH
- 487. 2928" DBH
- 488. 2934" DBH
- 489. 2940" DBH
- 490. 2946" DBH
- 491. 2952" DBH
- 492. 2958" DBH
- 493. 2964" DBH
- 494. 2970" DBH
- 495. 2976" DBH
- 496. 2982" DBH
- 497. 2988" DBH
- 498. 2994" DBH
- 499. 3000" DBH

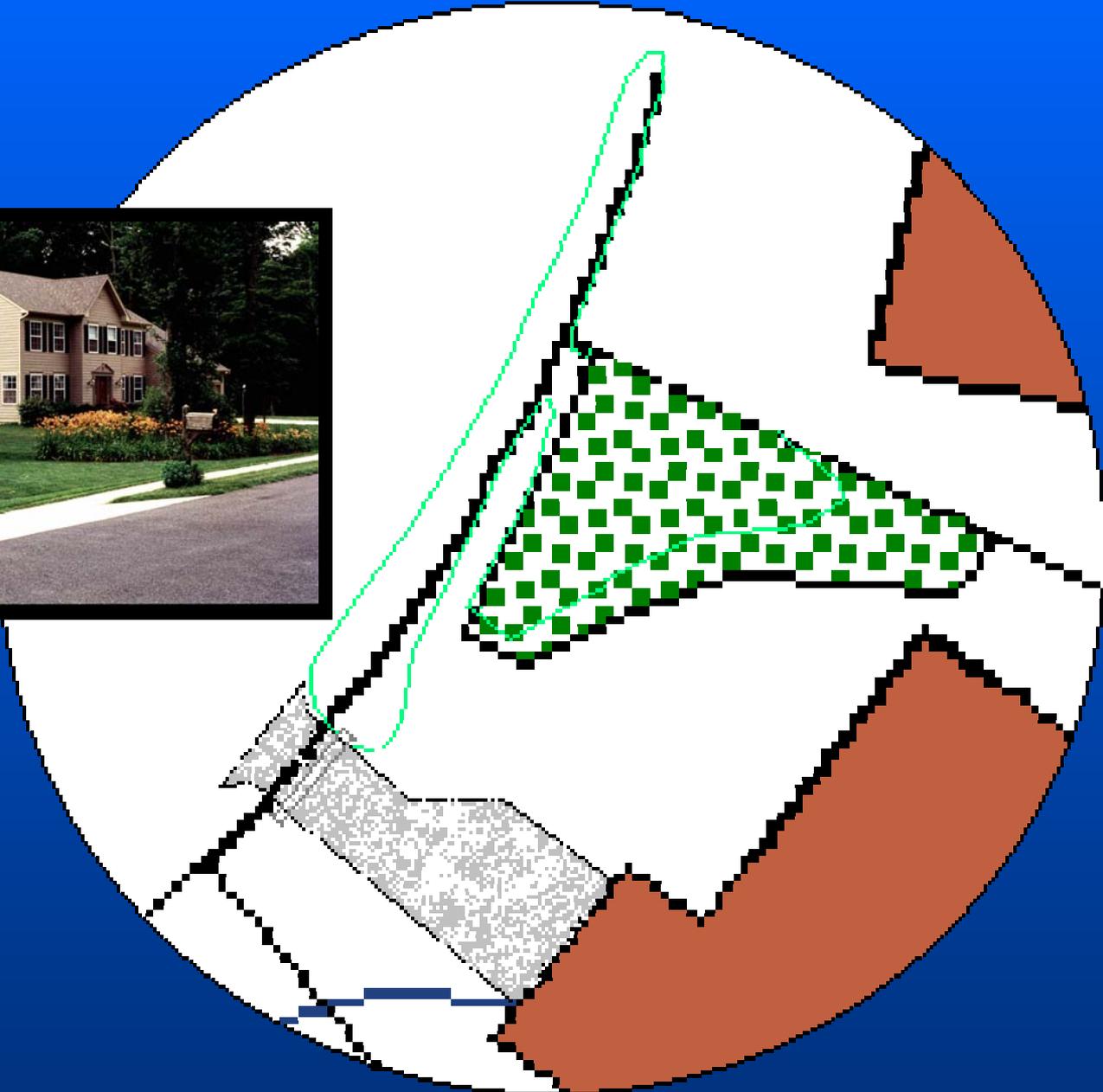
NO.	DESCRIPTION	QTY	UNIT	PRICE	TOTAL
1	12" DBH	1	000	000	000
2	18" DBH	1	000	000	000
3	24" DBH	1	000	000	000
4	30" DBH	1	000	000	000
5	36" DBH	1	000	000	000
6	42" DBH	1	000	000	000
7	48" DBH	1	000	000	000
8	54" DBH	1	000	000	000
9	60" DBH	1	000	000	000
10	66" DBH	1	000	000	000
11	72" DBH	1	000	000	000
12	78" DBH	1	000	000	000
13	84" DBH	1	000	000	000
14	90" DBH	1	000	000	000
15	96" DBH	1	000	000	000
16	102" DBH	1	000	000	000
17	108" DBH	1	000	000	000
18	114" DBH	1	000	000	000
19	120" DBH	1	000	000	000
20	126" DBH	1	000	000	000
21	132" DBH	1	000	000	000
22	138" DBH	1	000	000	000
23	144" DBH	1	000	000	000
24	150" DBH	1	000	000	000
25	156" DBH	1	000	000	000
26	162" DBH	1	000	000	000
27	168" DBH	1	000	000	000
28	174" DBH	1	000	000	000
29	180" DBH	1	000	000	000
30	186" DBH	1	000	000	000
31	192" DBH	1	000	000	000
32	198" DBH	1	000	000	000
33	204" DBH	1	000	000	000
34	210" DBH	1	000	000	000
35	216" DBH	1	000	000	000
36	222" DBH	1	000	000	000
37	228" DBH	1	000	000	000
38	234" DBH	1	000	000	000
39	240" DBH	1	000	000	000
40	246" DBH	1	000	000	000
41	252" DBH	1	000	000	000
42	258" DBH	1	000	000	000
43	264" DBH	1	000	000	000
44	270" DBH	1	000	000	000
45	276" DBH	1	000	000	000
46	282" DBH	1	000	000	000
47	288" DBH	1	000	000	000
48	294" DBH	1	000	000	000
49	300" DBH	1	000	000	000
50	306" DBH	1	000	000	000
51	312" DBH	1	000	000	000
52	318" DBH	1	000	000	000
53	324" DBH	1	000	000	000
54	330" DBH	1	000	000	000
55	336" DBH	1	000	000	000
56	342" DBH	1	000	000	000
57	348" DBH	1	000	000	000
58	354" DBH	1	000	000	000
59	360" DBH	1	000	000	000
60	366" DBH	1	000	000	000
61	372" DBH	1	000	000	0

# Detailed Engineering of Gardens



TYPICAL RAIN GARDEN PLAN DETAIL





# ***SIDE VIEW OF LOT 22/23 BIORETENTION***

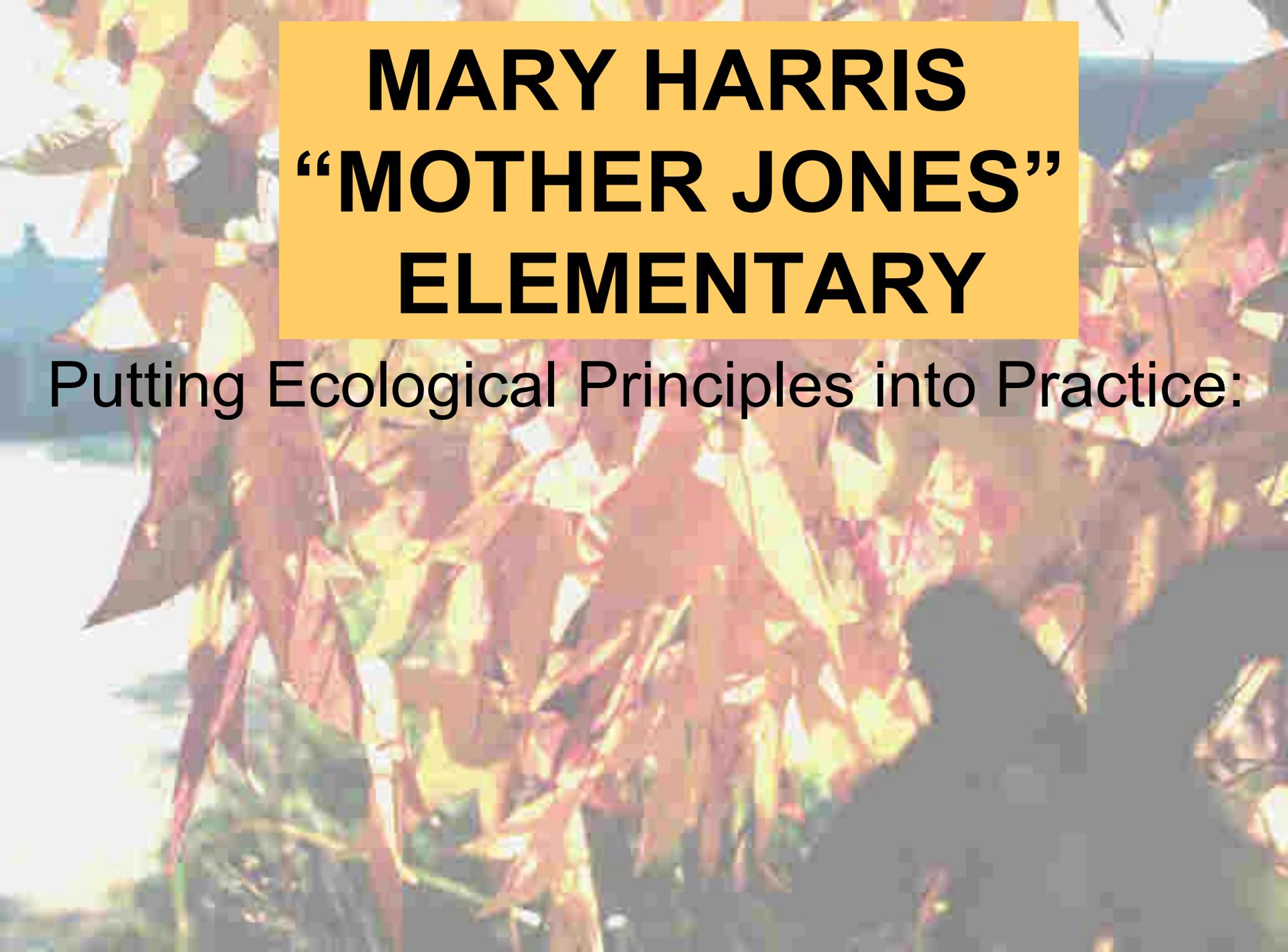




*Alternative Surfaces*

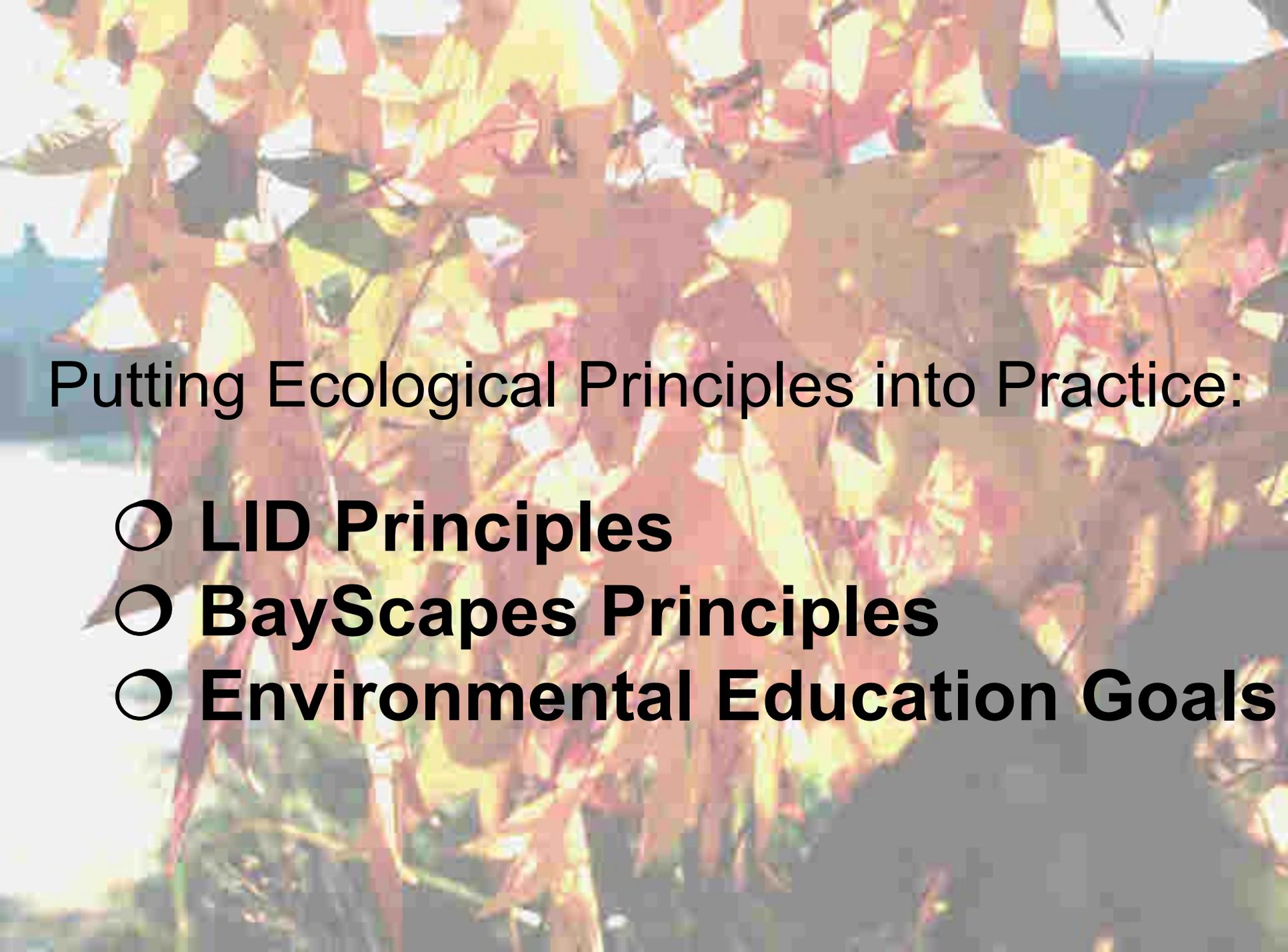
# *Rain Barrels, Cisterns and Storage Tanks*





**MARY HARRIS  
“MOTHER JONES”  
ELEMENTARY**

Putting Ecological Principles into Practice:

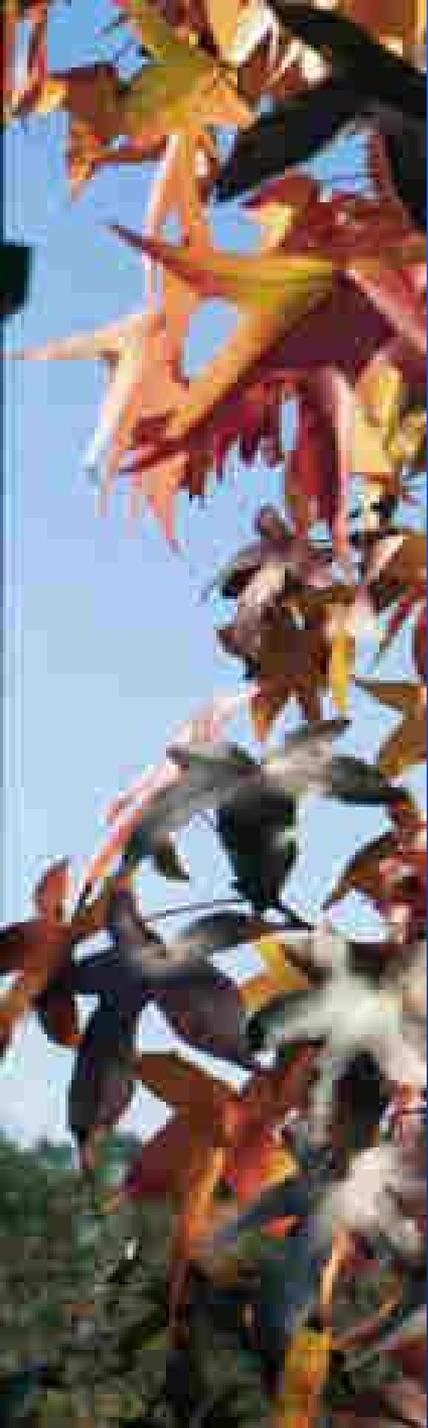


## Putting Ecological Principles into Practice:

- **LID Principles**
- **BayScapes Principles**
- **Environmental Education Goals**

# GOALS

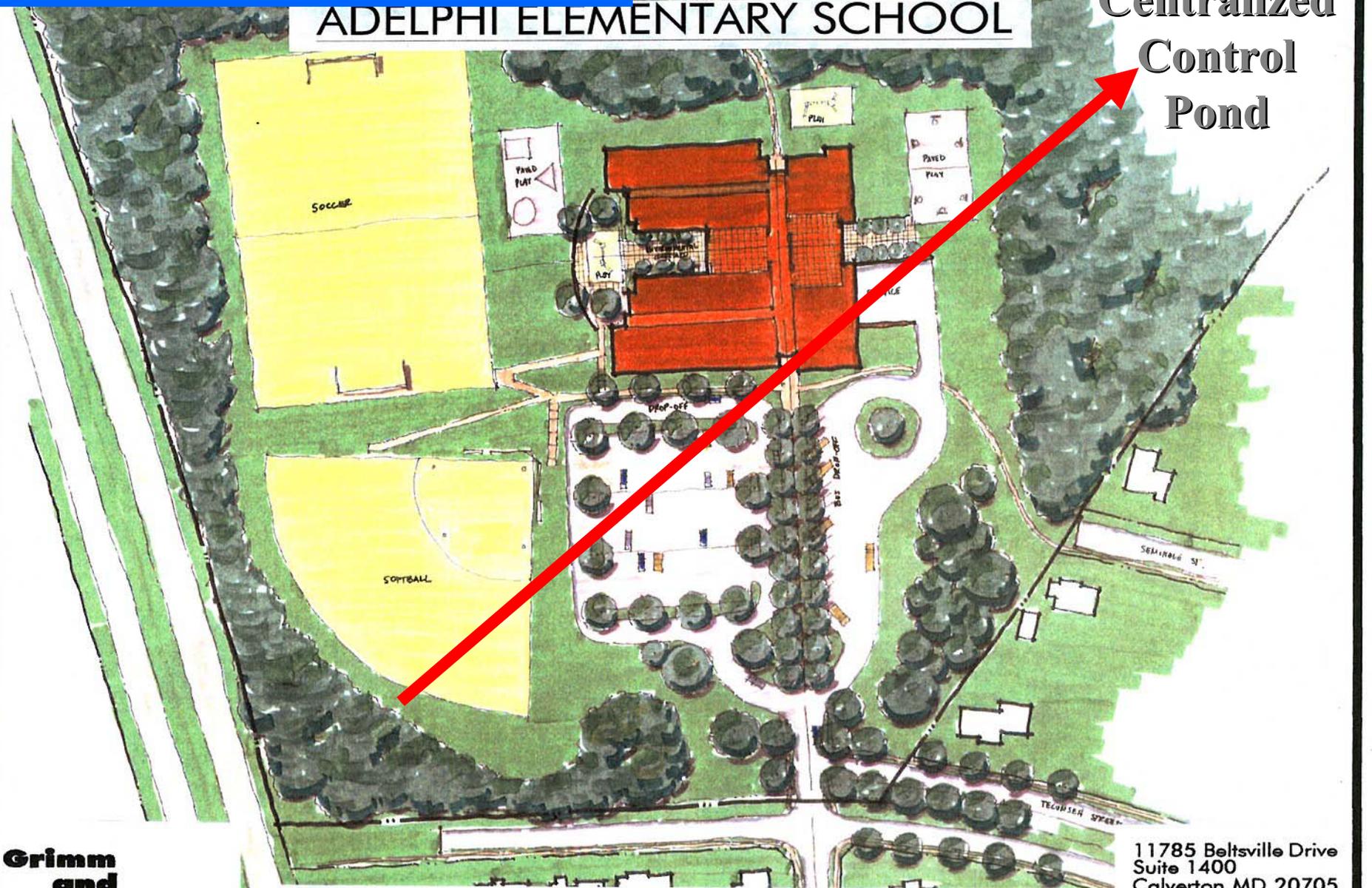
- ⌘ Preserve existing vegetation
- ⌘ Disconnect drainage flows
- ⌘ Utilize bioretention
- ⌘ Design low-input landscapes
- ⌘ Maximize biodiversity
- ⌘ Design habitats for wildlife
- ⌘ Provide outdoor classrooms
- ⌘ Involve students as stewards
- ⌘ Demonstrate stewardship



# 1: Initial Architect's Concept

ADELPHI ELEMENTARY SCHOOL

Centralized  
Control  
Pond



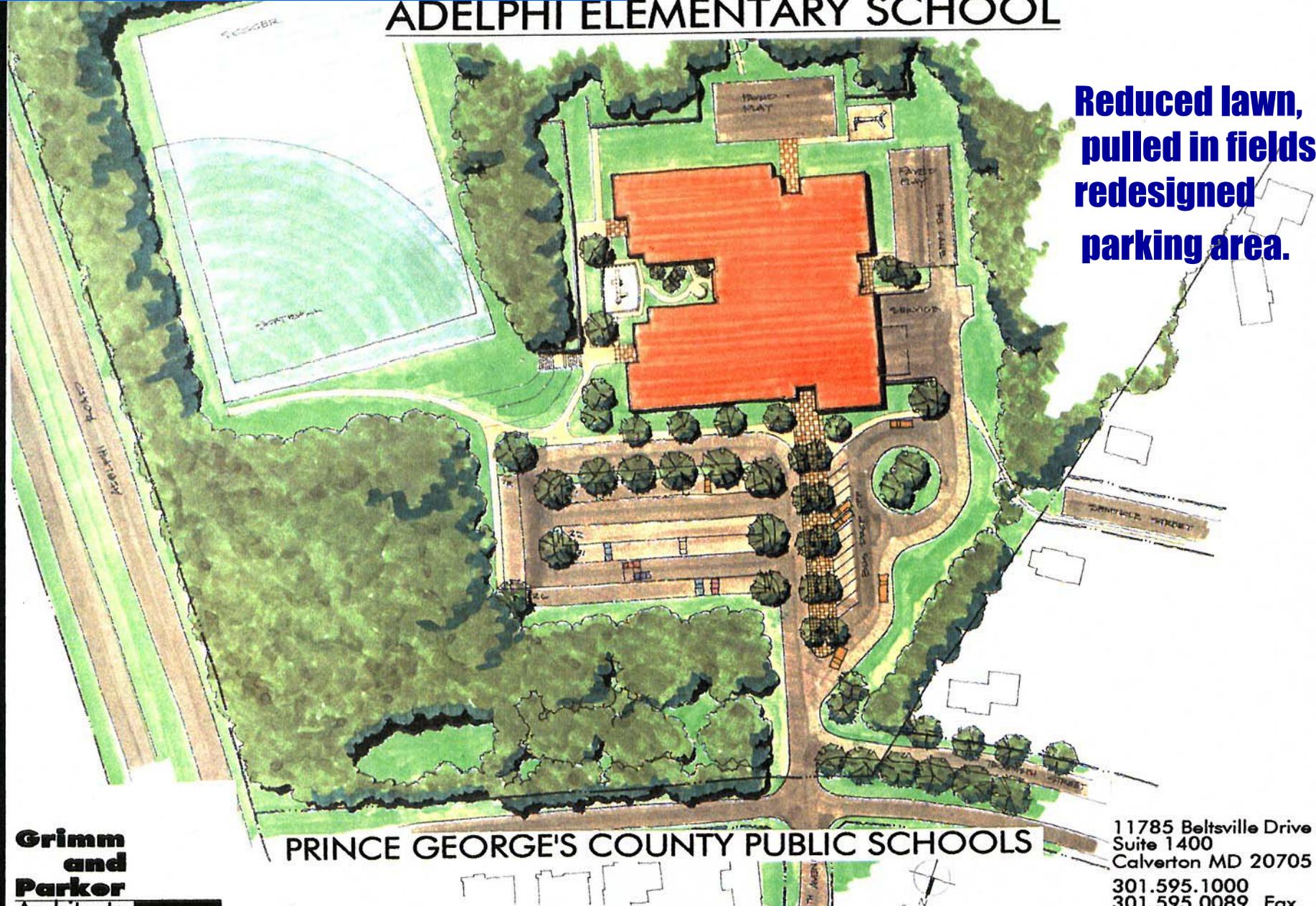
PRINCE GEORGE'S COUNTY PUBLIC SCHOOLS

**Grimm  
and  
Parker**  
Architects

11785 Beltsville Drive  
Suite 1400  
Calverton MD 20705  
301.595.1000  
301.595.0089 Fax

# 2: Revised Concept

## ADELPHI ELEMENTARY SCHOOL



**Reduced lawn,  
pulled in fields,  
redesigned  
parking area.**

**Grimm  
and  
Parker**  
Architects

PRINCE GEORGE'S COUNTY PUBLIC SCHOOLS

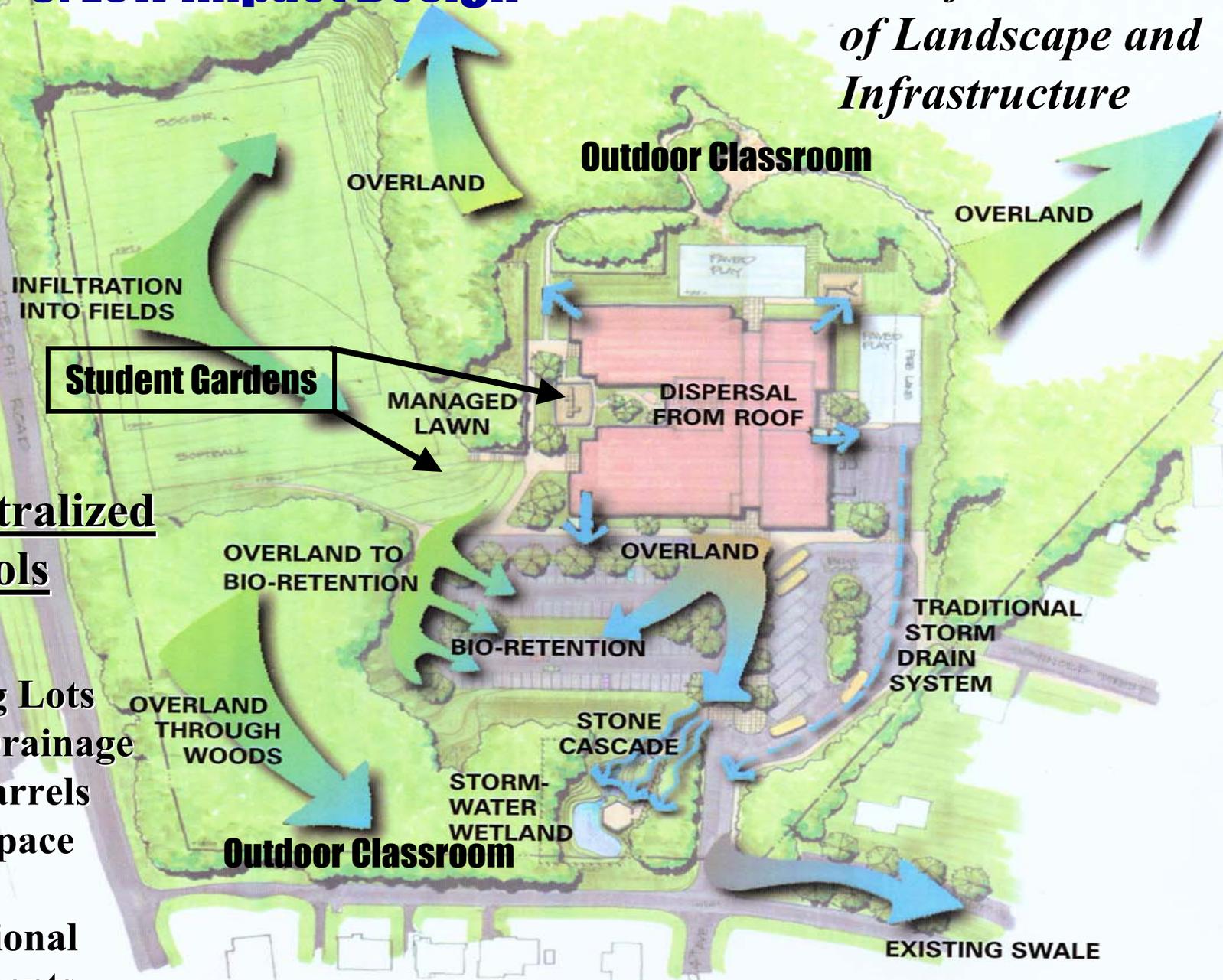
11785 Beltsville Drive  
Suite 1400  
Calverton MD 20705  
301.595.1000  
301.595.0089 Fax

**RESULT: 5 Acres of Trees Saved**



### 3: Low Impact Design

*Multifunctional Use of Landscape and Infrastructure*



### Decentralized Controls

- Roofs
- Parking Lots
- Open Drainage
- Rain Barrels
- Open Space
- Turf
- Educational components



School Under Construction



**Retaining Walls Minimize Grading**

## Extensive Use of Native Plants



Rain barrel for watering student garden





Existing Vegetation Preserved



Outdoor Classroom



Path to Undeveloped Woods / Stream



First Wetland Visitor

# BUTTERFLY ENHANCEMENT PROGRAM



Utility Right of Way / Meadow



# KEYS TO SUCCESS

- 📐 Assemble an interdisciplinary team involving all the project stakeholders.
- 📐 Consider stormwater management, landscaping, and educational goals at the conceptual design phase.
- 📐 Look for creative ways to turn site challenges into educational resources and environmental opportunities.

# *Summary of LID* *Techniques*

- (1) Recalculate Postdevelopment CN based on LID land use.
- (2) Increase Travel Time (TT) using LID techniques to achieve the same  $T_c$  as Existing conditions.
- (3) Retention: Provide permanent storage (Infiltration/Retention) using LID techniques to maintain the CN and runoff volume of existing conditions.
- (4) Detention: Provide additional detention storage to maintain the same peak discharge as existing conditions.